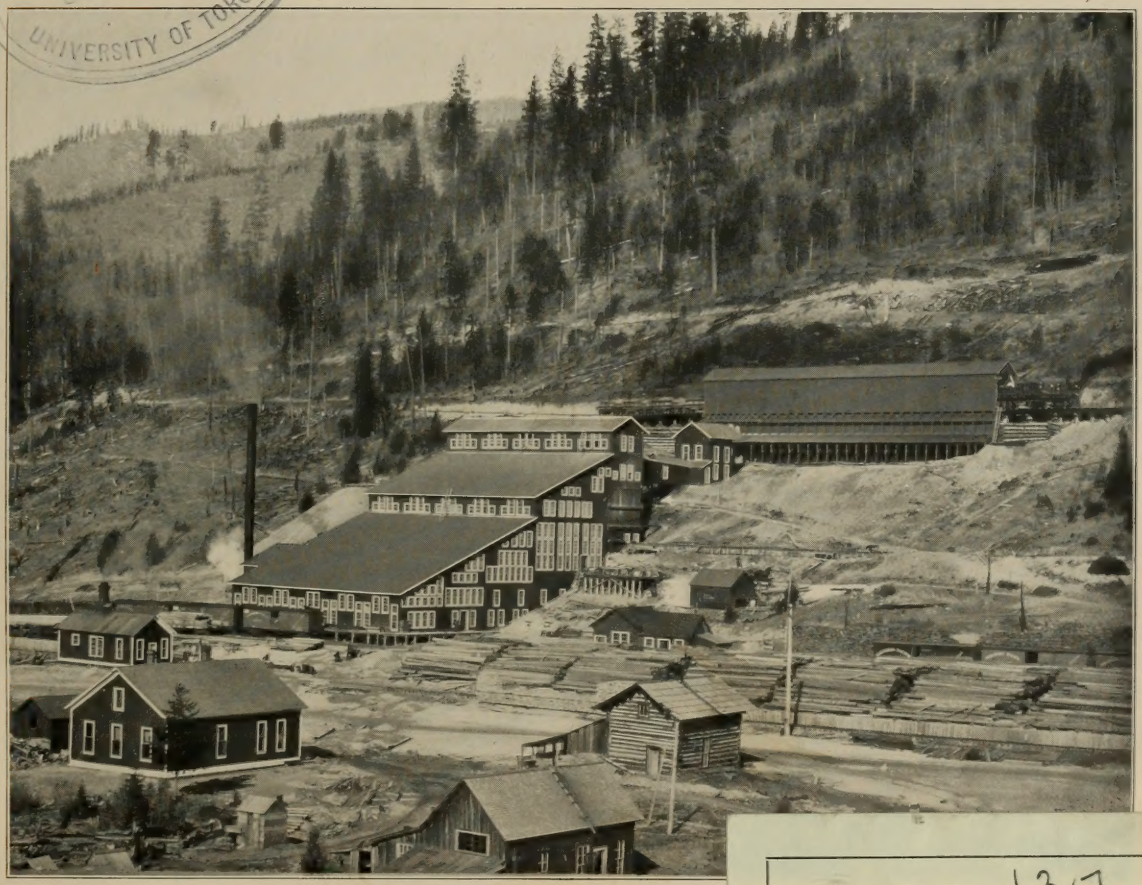
Manufacturing

Allis-Chalmers Company

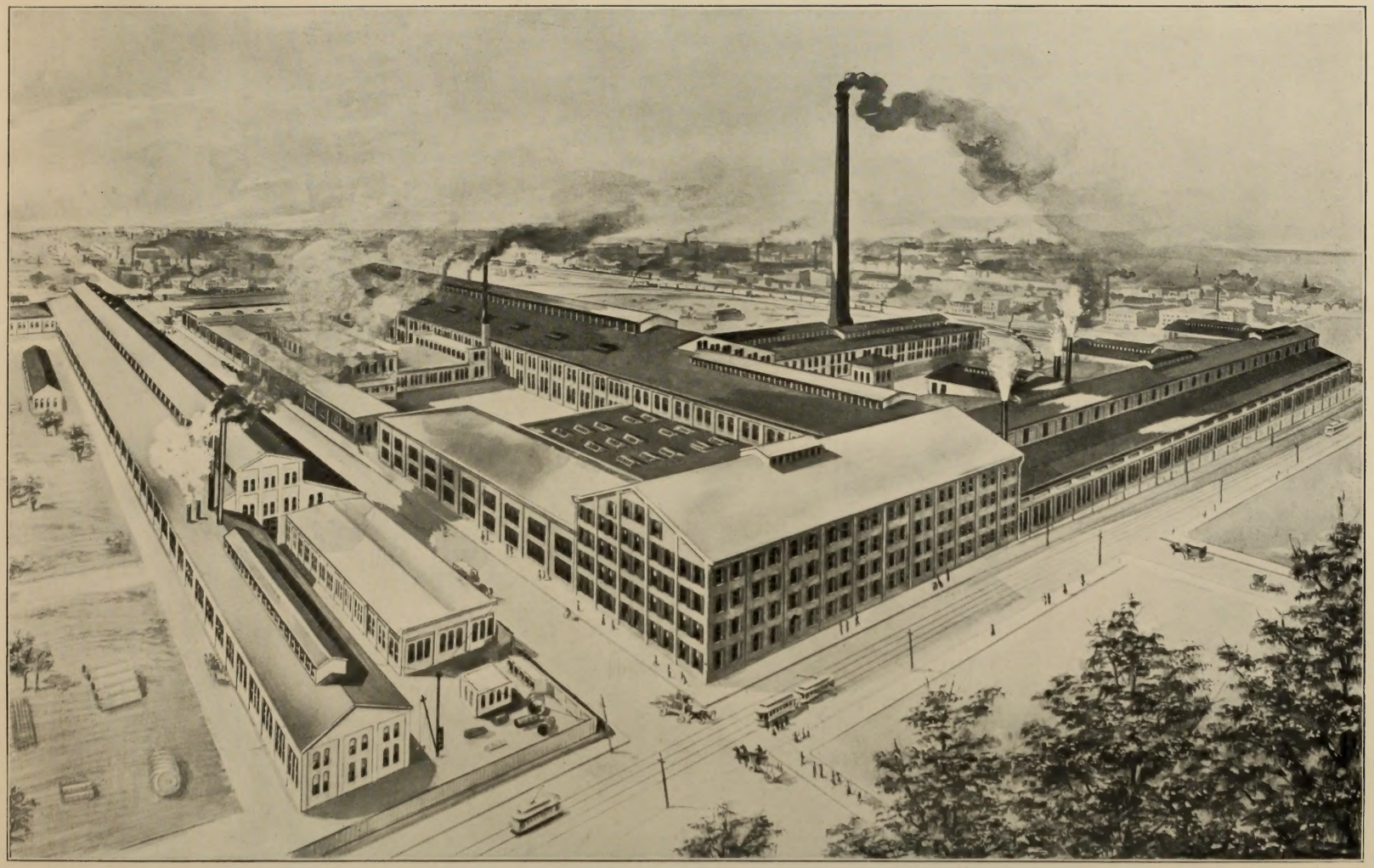
Mining Machinery Department

Bulletin No. 1437 | Superseding Catalogue No. 9 | January, 1909

Concentration of Lead, Zinc, Copper, Tin and Iron Ores



MILWAUKEE, WIS., U. S. A.



ALLIS-CHALMERS COMPANY'S CHICAGO WORKS No. 2

Where the Machinery described in this Bulletin is Manufactured.

Concentration—What It Embraces.

CONCENTRATION is ordinarly distinguished as coarse or fine, terms relating primarily to the size of the particles of material in the concluding stages of the process, whether granules if coarse, or slimes if fine.

COARSE CONCENTRATION.

Coarse concentration comprehends the coarse crushing of the ore (sometimes followed by picking and sorting), sizing in screens and hydraulic classifiers, and treatment upon jigs, which yield a product of clean or very valuable concentrates.

Since it is expensive and requires much power to pulverize rock, coarse concentration of the whole or of a portion of the ore represents an economy, and it is desirable to carry the crushing only so far as will permit the valuable contents of the ore to be separated from the gangue.

FINE CONCENTRATION.

Fine concentration is often a sequel to coarse, when it includes the treatment of the finer residual products of coarse concentration or of a middling-sized product subjected to finer crushing; or the ore may be crushed fine at the outset before being subjected to the processes of coarse concentration following partial crushing.

THE MOST ECONOMICAL PROCESS.

To avoid the greater difficulty in concentrating the values of finely divided material and the waste of energy and wear of machinery in needless grinding either of the gangue or the valuable minerals, where a portion of the valuable minerals can be separated in large crystals or granules, the process of concentration is usually tentative, first crushing coarse and separating the values in coarse form, and then proceeding with the residue in successive crushings and separations to get the smaller particles of valuable mineral out of the gangue, until we reach the residual slimes, whose values are obtained by the processes technically grouped as fine concentration.

WHERE FINE CRUSHING IS DESIRABLE AT THE START.

Concentrating ores with values chiefly of lead, zinc, copper, tin and iron are ordinarily treated by coarse concentration, with supplementary concentration of the finer residuals, but ores with values chiefly of gold and silver contain most of the precious metals in fine form, so that fine crushing is necessary to obtain them. Then the usual practice in concentration is to crush fine at the start and to concentrate all that can not be readily amalgamated of the fine gold and silver, as well as their heavy salts, popularly called sulphurets, etc.

IMPORTANCE OF PROPER METHODS OF CONCENTRATION IN TREATING LOW-GRADE ORES.

The ever increasing amount of low-grade ore which is being mined calls for methods of preparation for the market which combine cheapness and efficiency. Upon the success of these methods, in many instances, depend the future operations of the mines. These methods are all based on the principle of concentration, the mechanical separation of the mineral from the gangue in the ore.

INCREASING THE EFFICIENCY OF CONCENTRATING MACHINERY

With so much importance attached to this branch of the mining industry, there is a constant effort on the part of engineers to increase the efficiency of concentration by the design of new machinery, the perfection of design of the standard machines and the development of combinations of machines best suited to the conditions.

Allis-Chalmers Company, by virtue of its long experience in the manufacture of these products, its large and competent corps of engineers, and its complete shop equipment is fully prepared to furnish promptly the best and latest types of concentrating machinery to meet every demand.

This bulletin is presented as a condensed description of the up-to-date machinery, and an example of the concentrating plants designed and developed by the engineers of Allis-Chalmers Company, for the treatment of lead, zinc, copper, tin and iron ores.

Detailed descriptions of any of these machines or of those used in fine concentration may be had upon application.

MACHINERY FOR CONCENTRATION.

While the arrangement of a concentrating plant is variable, according to expert judgment of special conditions, the several machines which constitute its elements conform to a few generally approved types.

These we illustrate in about the order in which they are used in concentrating works, except machines described in our special bulletin on stamp mill practice, which may be had on application.

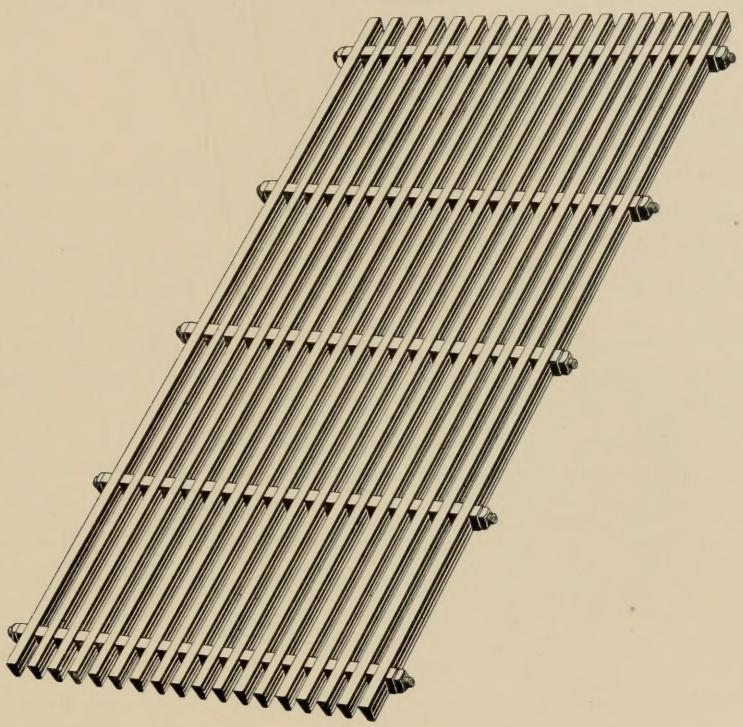
The machines and apparatus in general use for coarse concentrating plants are:

Grizzlies
Crushers
Ore Bin Gates
Feeders
Rolls
Elevators
Screens
Jigs
Huntington and Chilian Mills
Classifiers
Tables
Vanners
Pumps

GRIZZLIES

Plate 379 shows our standard grizzley or ore screen, which is built of special rolled tapered section bar ⅜″x¾″x3″. The grizzlies are made three or more feet in width and of any desired length or space opening. It is in all cases advisable to place the grizzley before the crusher so that the fines can be screened from the coarse rock and thus relieve the crusher from the duty of handling fine material.

Plate 379



STANDARD SIZES.

SIZE IN FEET		Opening, in Inches	Weight, in Pounds
Width	Length		
3	8	1	1125
3	8	1½	955
3	8	1¾	865
4	8	½	1950
4	8	1	1505
4	8	1½	1235
4	10	1	1885
4	10	1¼	1645
4	10	1½	1540
4	10	2	1365

The size of a grizzley depends upon the capacity required. The spacing of the bars and the angle of the grizzley depend upon the nature of the ore. The angle is usually 45° to 50°. Bars are of a taper section and are rigidly bolted together, spacers insuring uniform openings.

GATES BREAKERS.

In large concentrating plants where a great deal of crushing must be done, the Gates Gyratory Breaker, described in our Bulletin No. 1416, has supplanted the jaw types of crusher. The breaking is done between a cone placed on a gyratory shaft and a shell through which the shaft passes. The top of the shaft is held rigid while the bottom is given a gyratory motion by an eccentric, as described in more detail below. This machine has been eminently successful and is coming steadily into more general use in concentration work.

General Description of Breaker:

The heavy outer shell of the Gates Breaker is somewhat like an hour glass in shape. It is open at the top for receiving rock and has a spout inclined from one side of its lower lobe for discharging. From just below the mouth down to the place of the smallest diameter is the throat of the machine, where the actual rock breaking is accomplished.

The main shaft, suspended from great spider arms that span the top of the opening, passes through the throat and has keyed to it at that point a massive cone-like head, free to move within the throat walls, which are reinforced for wear.

The action of the head is somewhat peculiar, as it has a circular and rolling movement and approaches successively every point of the interior of the throat. This is accomplished by causing a movement of the lower end of the axis of the shaft around a small circle, the universal character of the spider journal at the top making this possible; consequently the axis of the main shaft is always slightly inclined to the true vertical axis of the machine.

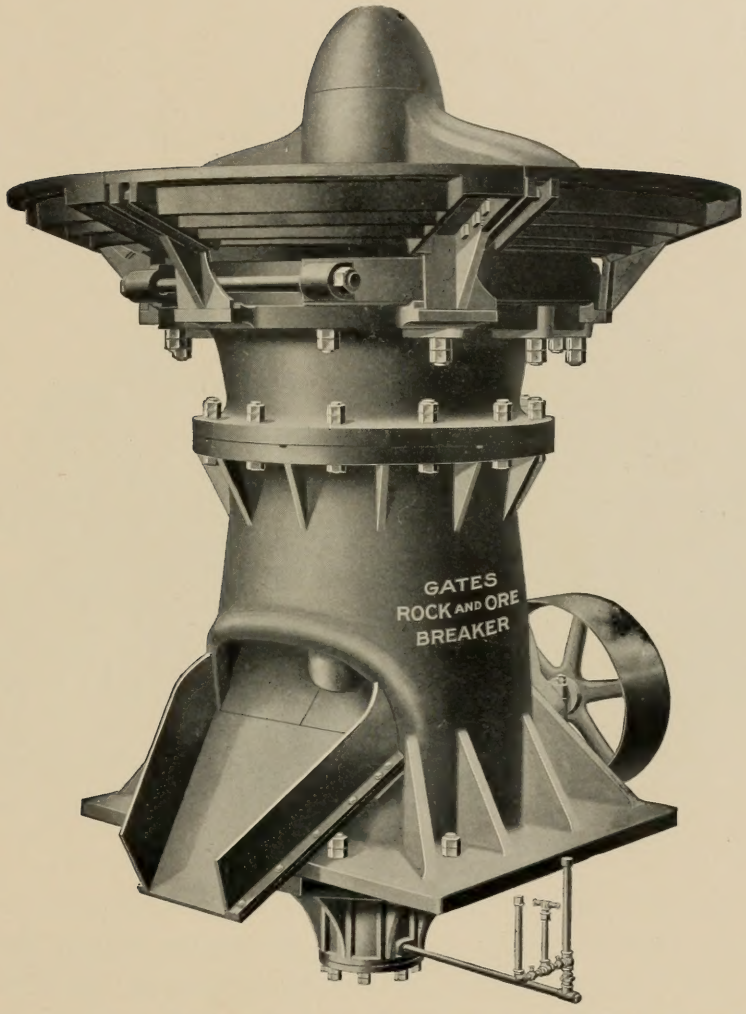
This action results in breaking the material, which then drops through by a continuous action at the successive places around the throat from which the head is most distant. The concave shape of the throat only permits the material to be in contact at its edges. This results in a clear break of the rock rather than crushing, so that the product is nearly cubical in form. The broken material falls on an inclined diaphragm, which protects the eccentric and gear. Passing over the diaphragm, it discharges itself at the spout by gravity.

The lower end of the shaft passes through a sleeve, which is bored off the center one-half the diameter of the required gyration, and attached thereto is a gear to which power is transmitted from the band wheel.

Material, falling between the inclined surface of the head and the oppositely inclined walls of the throat, by contact causes the shaft to slowly rotate on its axis in a direction opposite to its rapid gyratory movement.

The main shaft is adjustable and can be raised or lowered to regulate the size of the opening between concaves and head. This provides for altering the sizes of the product or for taking up the wear and keeping the product uniform.

Plate 1440



DIMENSIONS, WEIGHTS, CAPACITIES AND REQUIRED POWER.

STYLE "K."

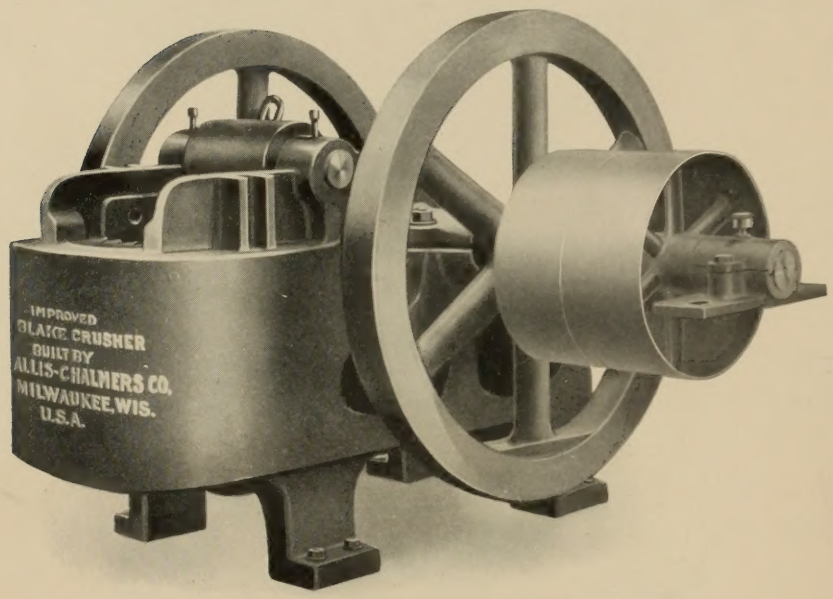
Size	Dimensions of Each Receiving Opening, About	Weight of Breaker	Capacity per Hour, According to Character of Rock or Ore, in Tons of 2000 Lbs., to Pass Through a Ring of—								Smallest Size of Product of Mach.	Dimensions of Driving Pulley	Revolutions of Driving Pulley	Horse-Power Required
	Inches	Lbs.	1½	1¾	2	2½	3	3½	4	5	Inches	Inches		
4	8 x 30	20900	15	20	25	30	40				1½	32 x 12	400	14 to 21
5	10 x 38	31200		30	40	50	60	70			1¾	36 x 14	375	22 to 30
6	12 x 44	45500			50	70	80	90			2	40 x 16	350	28 to 45
7½	14 x 52	64800				80	90	100	120		2½	44 x 18	350	50 to 75
8	18 x 68	100000						130	150		3½	48 x 20	350	70 to 110
9	21 x 76	153000							250	300	4	56 x 20	300	100 to 150
18	Information furnished on application.													

POWER—The estimate of power required is for Breakers only, no allowance having been made for Elevators or Screens.

NOTE: Sizes smaller than No. 4 are not made in "K" style. For these sizes refer to Style "D" Bulletin.

BLAKE CRUSHER.

Plate 4701

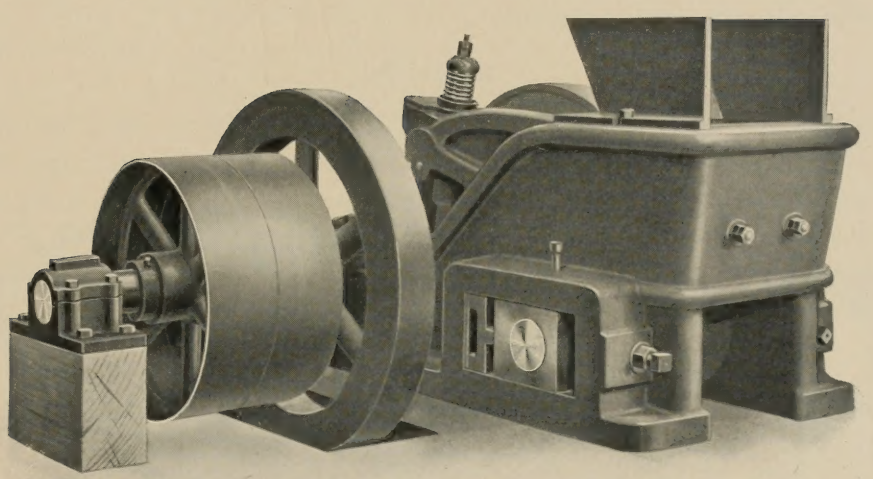


The Blake Crusher (plate 4701) has long been a standard machine for reducing rock preparatory to finer crushing or pulverizing by stamps, rolls or Huntington Mills. It is durable and simple to operate, being now so well-known as to require little explanation.

Size of Receiving Opening	Horse-Power Required	No. of Tons Per Hour Jaws 1½″ Apart	Revolutions Per Minute	Weight, Complete	Weight of Heaviest Piece	Remarks
10″ x 4″	4	2 to 3	250	5250 lbs.	2140 lbs.	Standard
10″ x 7″	7	4 to 6	250	8750 lbs.	4180 lbs.	Standard
10″ x 7″	7	4 to 6	250	9000 lbs.	2250 lbs.	Semi-Sectional
10″ x 7″	7	4 to 6	250	8000 lbs.	385 lbs.	Std. Sectional
10″ x 7″	7	4 to 6	250	9800 lbs.	250 lbs.	Special Sectional
15″ x 5″	8	4 to 8	250	12400 lbs.	5620 lbs.	Special
15″ x 9″	10	6 to 10	250	16950 lbs.	7500 lbs.	Standard
20″ x 10″	14	10 to 15	250	22800 lbs.	9660 lbs.	Standard
24″ x 12″	20	15 to 20	250	46200 lbs.	20050 lbs.	Standard

DODGE CRUSHER.

Plate 4669



The Dodge Crusher (plate 4669) has been long and favorably known for its simplicity of construction, ease and range of adjustment, accessibility of all working parts, together with the uniformity of its product. In comparison with the "Blake" crusher the "Dodge" can be set to crush finer though the "Blake" has the greater capacity.

Size of Jaw Opening	Horse-Power Required	No. of Tons Per Hour, Nut Size	Revolutions Per Minute	Weight, Complete	Weight of Heaviest Piece
4″ x 6″	3	½	300	1100 lbs.	310 lbs.
7″ x 9″	6	1½ to 2½	300	3250 lbs.	1035 lbs.
7″ x 9″ Sectional	6	1½ to 2½	300	3350 lbs.	250 lbs.
8″ x 12″	10	3 to 5	300	5900 lbs.	2000 lbs.
11″ x 15″	15	6 to 8	250	13500 lbs.	4015 lbs.

ORE BIN GATES.

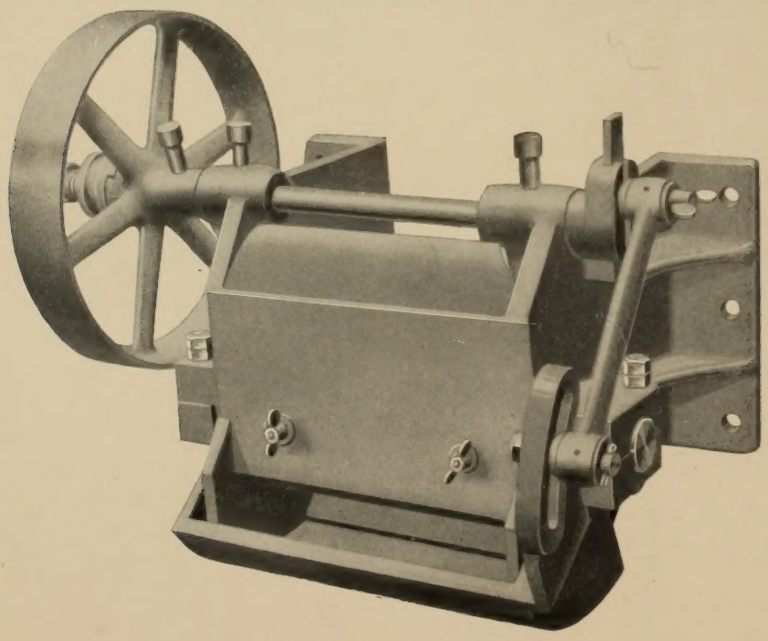
The standard gate for ore bins is made of sheet iron, running in iron guides at the sides operated by means of a rack and pinion, and for general use is best. The finger or lever types of gates are sometimes specified for special purposes. Our designs include every practical form of bin gate known.

FEEDERS.

For feeding into rolls in most cases, the wall type, belt or chain driven feeder is specified. It consists essentially of a chute covered by a hinged pan, which is moved backward and forward by a crank and connecting rod. This feeder is dependable for steady work and ease of adjustment. For certain classes of ore the positive acting plunger feeder is specified. In cases where special designs of feeders are required, we are prepared to furnish them.

AUTOMATIC BELT DRIVEN FEEDER.
(Known as the Wall Type)

Plate 1906

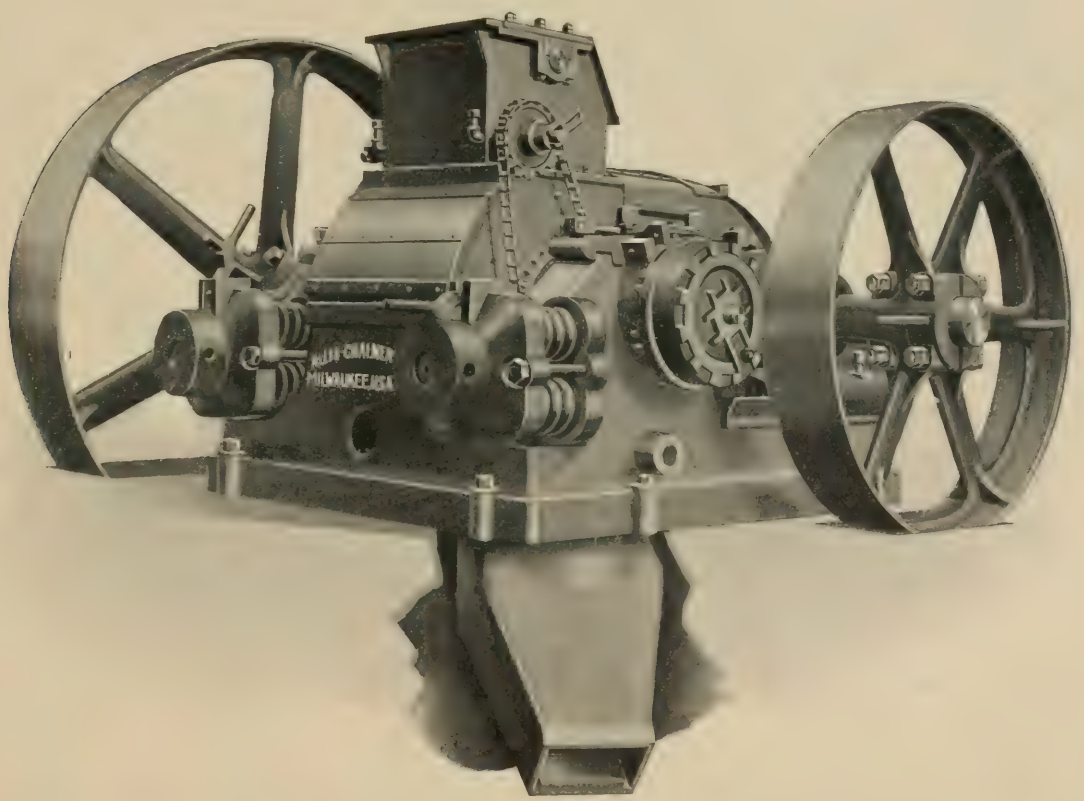


Rolls.

Secondary grinding up to a certain point, depending on the nature of the ore, is usually done on rolls. It is necessary that these machines combine strength, large capacity, ease and fineness of adjustment and good wearing qualities. These points have been followed in the design of our rolls, which are made in six styles, all sizes, to suit all conditions of crushing. For detailed information concerning them we refer the reader to Bulletin No. 1412.

STYLE "A" CRUSHING ROLL.

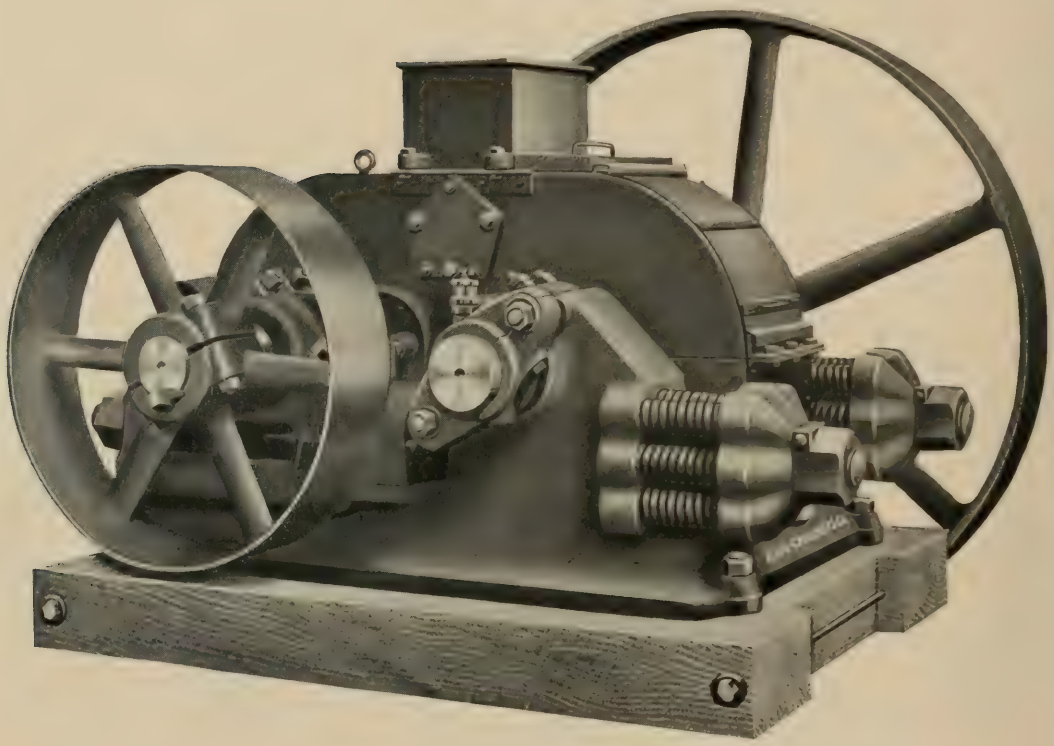
Plate 1389



Size of Rolls inches Dia. x Face	Size of Driving Pulleys inches Each Roll	Revolutions per Minute
26 x 15	One 72 x 12 and One 48 x 8	75 to 125
36 x 15	One 96 x 15 and One 72 x 8	40 to 100
54 x 20	One 108 x 14½ and One 60 x 9½	30 to 75

STYLE "B" CRUSHING ROLLS.

Plate 4338



Size of Rolls Inches Diameter By Face	Sizes of Driving Pulleys, Inches Each Roll with	Revolutions Per Minute	Total Weight Pounds Without Housing	Add for Weight of Sheet Steel Housing, Lbs.
24″ x 8″	One 60″x 8 ½″ and One 26″x 8 ½″	65 to 160	10,500	400
24″ x 10″	One 60″x 8 ½″ and One 26″x 8 ½″	65 to 160	11,000	425
24″ x 12″	One 60″x 8 ½″ and One 26″x 8 ½″	65 to 160	11,500	450
24″ x 14″	One 60″x 8 ½″ and One 26″x 8 ½″	65 to 160	12,000	475
30″ x 10″	One 78″x10 ½″ and One 34″x10 ½″	50 to 130	16,000	600
30″ x 12″	One 78″x10 ½″ and One 34″x10 ½″	50 to 130	16,900	650
30″ x 14″	One 78″x10 ½″ and One 34″x10 ½″	50 to 130	17,800	700
30″ x 16″	One 78″x10 ½″ and One 34″x10 ½″	50 to 130	18,700	750
36″ x 12″	One 84″x10 ½″ and One 42″x10 ½″	40 to 110	23,000	900
36″ x 14″	One 84″x10 ½″ and One 42″x10 ½″	40 to 110	24,100	950
36″ x 16″	One 84″x10 ½″ and One 42″x10 ½″	40 to 110	25,200	1000
42″ x 16″	One 84″x17″ and One 54″x11″	35 to 90	31,000	2000

STYLE "C" ROLLS.

For less exacting service we manufacture, in several standard sizes, crushing rolls designated as style "C" Rolls. Special sizes of these rolls may also be had.

While these rolls have given great satisfaction for years in the class of work for which they are adapted, they do not embody all the improvements to be found in the higher grade rolls of our production. They are more fully treated of in Bulletin No. 1412 to be had upon request.

ANACONDA TYPE OF HEAVY CRUSHING ROLLS.

Plate 2065 illustrates a type of crushing rolls that is known as the "Anaconda", having been originally designed for the large concentrating mill of the Washoe Works at Anaconda, where they have 36 sets of these rolls in operation.

They are of very heavy and substantial construction throughout, the frame being strongly ribbed and very heavy to withstand the crushing strains set up in same.

The bearings are of ample proportions and carried in heavy boxes, two of which are arranged in swivel brackets to permit the passage of hard substances through the machine without breaking.

The roll shafts are of very liberal dimensions and are provided with double taper hubs, by means of which the shells are held in place. These shells are ordinarily made of the best quality rolled steel.

A suitable discharge hopper is provided for the product of the machine and a housing with flexible cover is provided to prevent the splash or dust from getting beyond the machine. The housing is also provided with a suitable feed hopper having deflecting plates and wearing plates for distribution of the ore across the face.

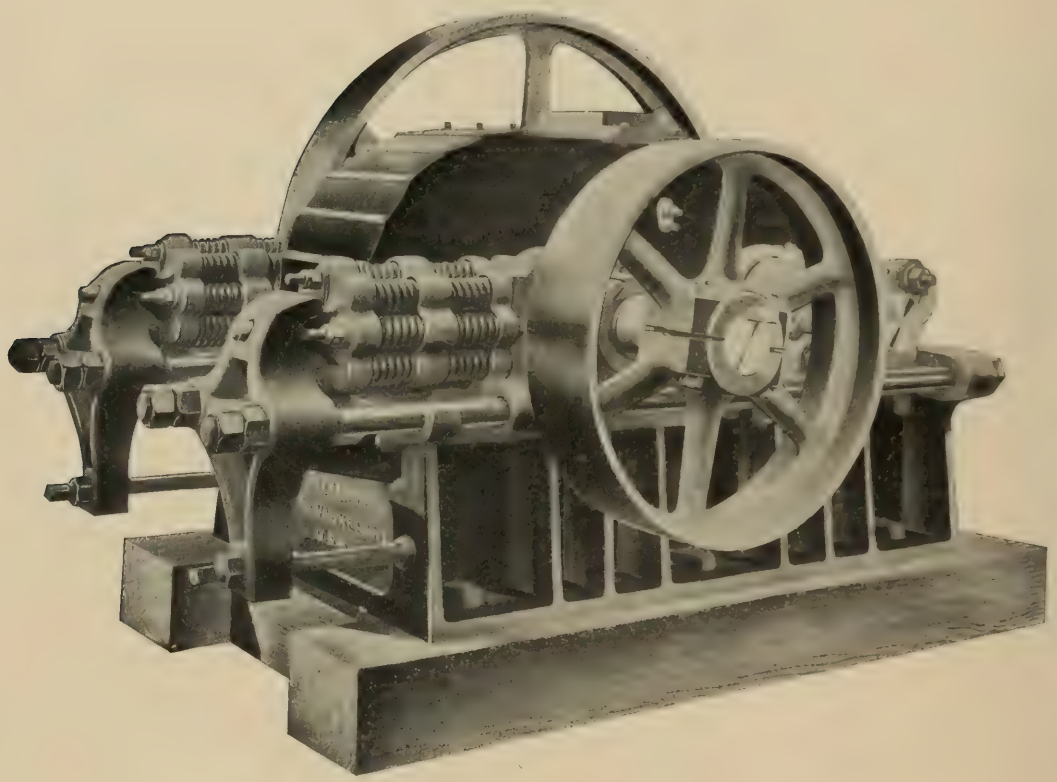
A suitable means of side adjustment is provided for keeping the rolls in proper alignment and will permit giving the maximum wear and avoid corrugating as much as possible.

The machine is very strongly designed throughout, is simple in its parts and can easily be adjusted to suit the operating conditions.

In addition to the installation at the Anaconda Works, these machines have been installed in a great many of the large plants throughout the country.

SPECIAL EXTRA HEAVY CRUSHING ROLLS

Plate 2065



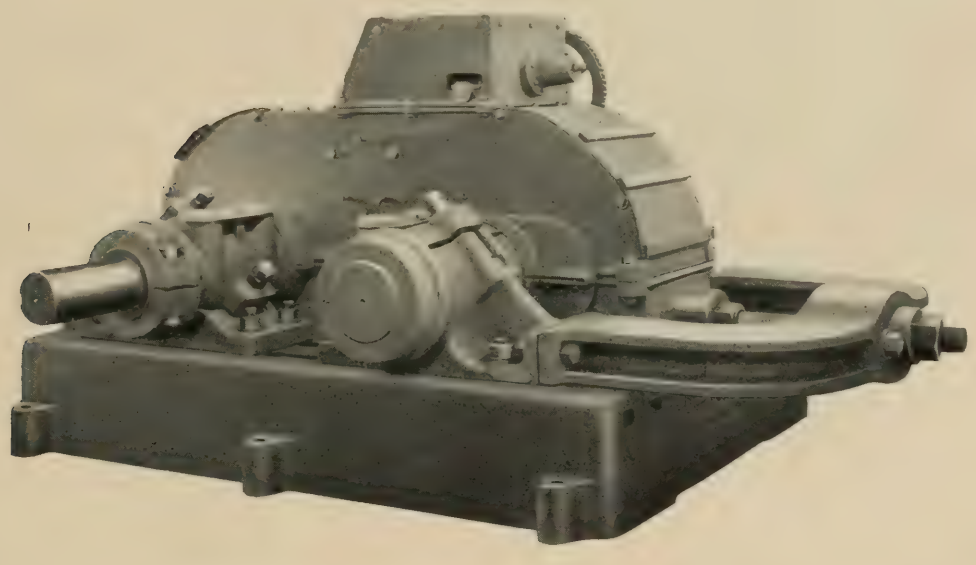
Size of Rolls, Inches, Diameter By Face	Size of Driving Pulley, Inches, Each Roll with	Revolutions per Minute	Total Weight with Housing, Pounds
40″ x 15″	One 96″x12 ½″ One 48″x12 ½″	50 to 100	38,000
40″ x 30″	One 96″x12 ½″ One 48″x12 ½″	50 to 100	50,000
40″ x 36″	One 96″x12 ½″ One 48″x12 ½″	50 to 100	52,000

RIGID ROLLS

The Rigid Rolls offered by this Company are very strongly built and especially adapted to the character of the service for which they are required.

The frame is made of cast iron in one piece and is self-contained. It is of ample proportions and of strong box section. It is planed upon the bottom to be set on either timber or concrete foundations and is provided with holes for six foundation bolts. These bolts are placed three on each side, and the center bolt is placed in the center of the frame where the greatest strain occurs from the continuous vibration; by this construction the frame can be bolted down securely at the center as well as at the ends, thereby guarding against the possibility of breakage.

Plate 4360



Size of Rolls, Inches, Diameter By Face	Size of Driving Pulley, Inches, Each Roll with	Revolutions per Minute	Total Weight with Housing, Pounds
36″ x 10″	One 78″x10 ½″ One 34″x10 ½″	50 to 100	21,550
36″ x 15″	One 84″x10 ½″ One 40″x10 ½″	50 to 100	25,530

GATES STYLE "B" ELEVATORS.

Plate 1321

Geared Elevator, Left-Hand Driven.

These elevators are built from our special designs, and more than two thousand of them are in successful operation.

For elevating the finished product as it is discharged from the rock crusher and carrying it into bins or other storage deposits, this type of elevator cannot be excelled. Our large and varied experience in the manufacture of this class of machinery has taught us that a rubber belt used for carrying the buckets is far ahead of anything else heretofore introduced for the same purpose, and we recommend it without hesitation to prospective purchasers as being superior in every respect to what is known as a chain elevator, where the buckets are carried on and fastened to the links of the chain.

Elevators Nos. 2, 4 and 5, when less than thirty feet in length, are usually furnished of the single head pattern. All of the larger sizes are supplied with the geared head, as shown in Plate 1321.

We furnish these elevators of any desired length. The length most commonly in use averages about forty feet.

DIMENSIONS AND WEIGHTS OF GATES STYLE "B" ELEVATORS.

HEAD	Size of Elevator	Size of Breaker	Distance Between Centers	Size and Gauge of Buckets	Width of Belt	Weight	Revolutions of pinion shaft on Geared Head	Revolutions of Head Shaft
			FEET		INCHES	POUNDS		
Single Heads to 30 ft in Length	2	1 and 2	30	9x 9, No. 16	10	2200	162	32
	3	3	30	11x 9, No. 16	12	2600	162	32
	4	4	30	13x10, No. 14	14	2800	160	32
	5	5	30	16x11, No. 14	18	3500	168	27
Geared Heads	6	6	30	18x12, No. 12	20	4700	139	23
	7½	7	30	24x13½, No. 12	26	8000	132	21
	8	8	30	30x15, No. 10	32	11300	108	19
	9	9	30	36x16, No. 3/16"	38	15100	100	18

BELT AND BUCKET ELEVATORS

Plate 409

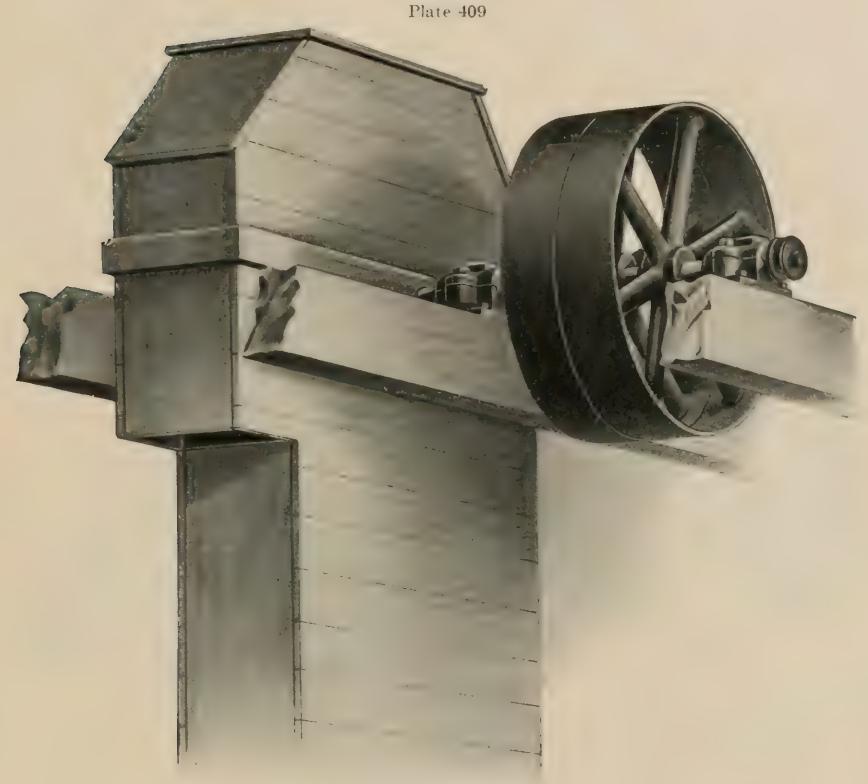


Plate 355M

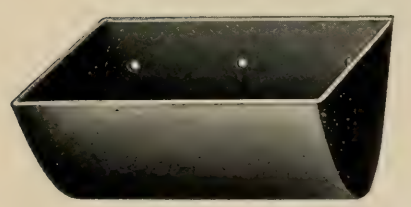
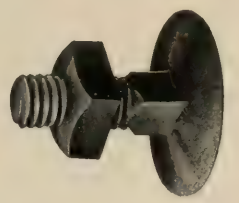


Plate 356M



We have found by experience that for elevating gritty material, such as wet or dry quartz, pulp, etc., nothing will give better satisfaction than a Belt and Bucket Elevator. The probable source of trouble with elevators is the lack of sufficient capacity. Elevators should be designed to have a capacity several times greater than the quantity of material to be conveyed, because in nearly all cases the work is more or less intermittent.

We design elevators to suit all sorts of conditions and requirements, and if erected in accordance with detailed instructions furnished by us, will do all that they are designed for. We furnish belt of the best quality suitable for this purpose. Our elevator buckets are made of pressed steel, cast steel, or malleable iron, of such design that they will discharge properly.

The head shaft is fitted with pulley or with spur gears, and extra shaft with pulley depending on size and height of elevator.

Screens

Trommels, screens and sizers are used in every mill to a greater or less extent. They must have capacity and efficiency with minimum power and mill space. The size, shape and velocity, as well as the kind of screen covering, are dependent upon the character of the ore and the machines following the trommels. Our trommels are made cylindrical, conical, double conical, hexagonal parallel, double hexagonal parallel and hexagonal tapering and are designed for large capacity and good wearing qualities. They can be furnished completely equipped for running in series from a single drive.

Plate 4227

TROMMEL OR CYLINDRICAL REVOLVING SCREEN

The above illustration shows one of our plain cylindrical revolving screens arranged for delivering three different-sized products. By a different arrangement of the perforated screen covering and screen housing, the same style of screen can be made to deliver any number of different sizes of product desired.

In setting the cylindrical screen, it is necessary that the end which receives the ore to be screened should be higher than the end from which the product is delivered.

REVOLVING SCREENS FOR WET SIZING

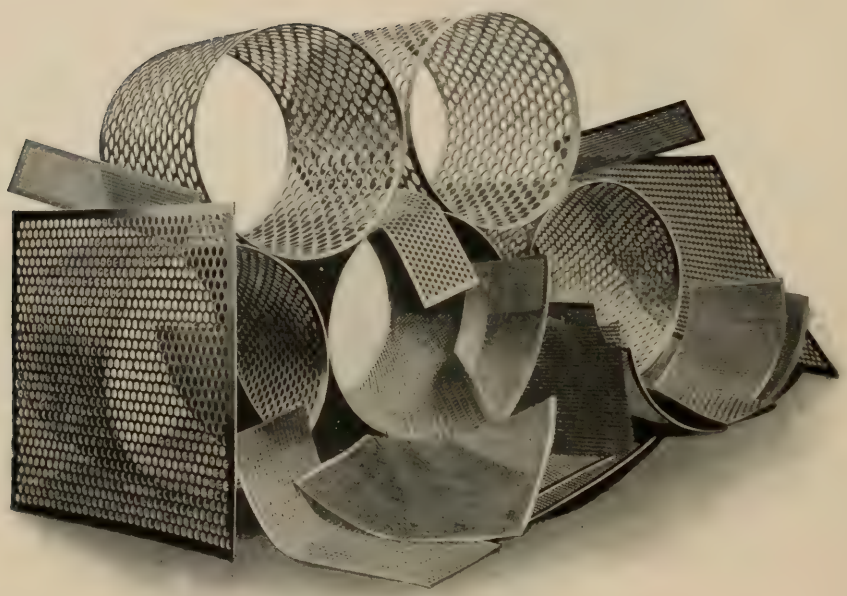
Sizing screens constitute a very important part of a Concentration Mill, as the success of the treatment depends upon effective sizing, which is followed by the proper separation of the sized particles according to the specific gravity of the various minerals of the ore to be treated. Plate 1023 shows a common arrangement of three revolving screens in which either perforated metal or wire cloth may be used. Bevel gearing is shown driving the last screen, which communicates motion by spur wheels to successive screens having larger perforations or meshes and placed at higher levels. In concentrating works, sets of three or more such screens are usually employed. The first screen takes out all pieces too large for the processes of ore treatment, that they may be returned to the crushing machinery. The remainder passes through the perforations of the first screen, and is conveyed to the second screen, and so on through the set, each screen furnishing a product

sized between the limits of its perforations and the perforations of the preceding screen, and the last screen a product of all that passes the finest perforations.

Plate 1023

PERFORATED SHEET METAL

Plate 1309

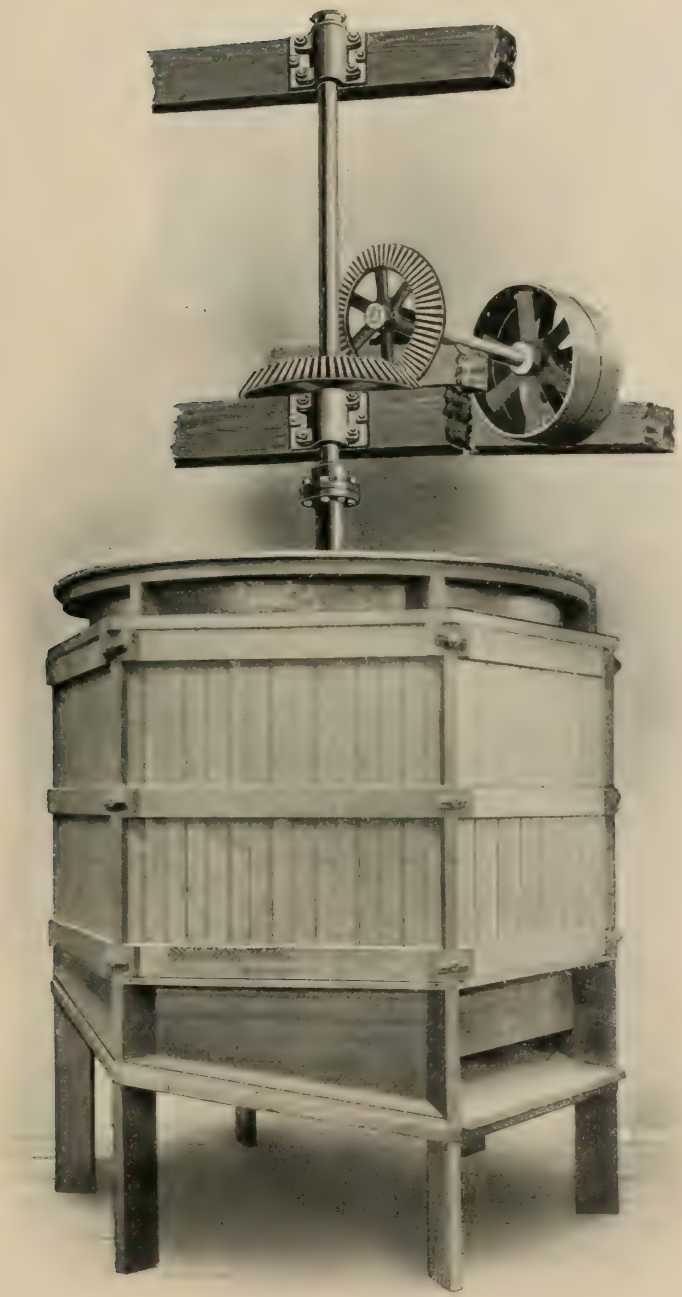


We can furnish perforated plates of iron, copper, brass, steel, zinc, tin, aluminum and other metals, of thickness ranging from 30 gauge to 3/8 inch, with size of perforations proportioned to thickness of metal, and spaced, if desired, as close as the thickness of the metal will permit.

For detailed information see our Bulletin No. 1425.

THE PRATT-WETHEY SIZING SCREEN.

Plate 844



This screen shows a departure from the ordinary operation in sizing ore, since the screen is stationary and the moving element is a distributor, which discharges the pulp against the screen by centrifugal force.

The Pratt-Wethey screen is designed to operate on fine feed of too small mesh to be successfully sized by standard trommels.

The operation of this screen is essentially as follows:—

The pulp or ore is set into a revolving distributor provided with six openings through which the pulp is discharged against a perforated screen of conical shape. The distributor revolves at 125 R. P. M. Due to the force with which the material strikes the screen, no blinding of the screens occurs.

Jigs.

Jigging machinery is almost universally employed for coarse material, and covers a great variety of designs practically alike in principle and differing little in work done if the conditions are equally favorable.

HANCOCK JIG.

This jig, which we describe in Bulletin No. 1403, is essentially a low-grade ore machine, having been originally designed for the treatment of the lean copper, lead and zinc ores of South Australia. The success of this machine has been wide-spread, so much so, that although comparatively new, it holds a high place in the estimation of the mining public. Every point of its design is directed toward economy and efficiency. Its principle differs from that of the plunger jig, in that the screen is the moving element, causing a positive pulsation, the resultant of a vertical and horizontal motion, under the absolute control of the operator.

Some of the special features are:—

1—A very large capacity. This high tonnage is due to the positive motion and forward throw, by which the operator can send the feed across the screen as rapidly as is consistent with good separation. It will handle 100 to 600 tons of material in 24 hours, depending on mineral contents of ore. This is economical in that it will take the place of a great number of plunger jigs.

2—Ability to handle unsized feed. The jig will handle a feed ranging from 5/8" to 30 mesh if necessary. Thus it will do away with all screens, except an oversize screen and a specially designed classifier to separate the material from the feed which is less than 30 mesh.

To sum up the advantages we have:—

1—Saving of power, requiring 5 H. P., which is less than 1-5 as much as for plunger jigs, doing the same amount of work.

2—Saving of water, less than 50% as much as plunger jigs require.

3—Saving of mill space, occupying a floor space of 4'-2"x25'.

4—Less number of attendants required in mill.

5—Cost of mills much lower on account of requiring less screens, less head room and less floor space.

THE HANCOCK JIG.

Plate 1954.

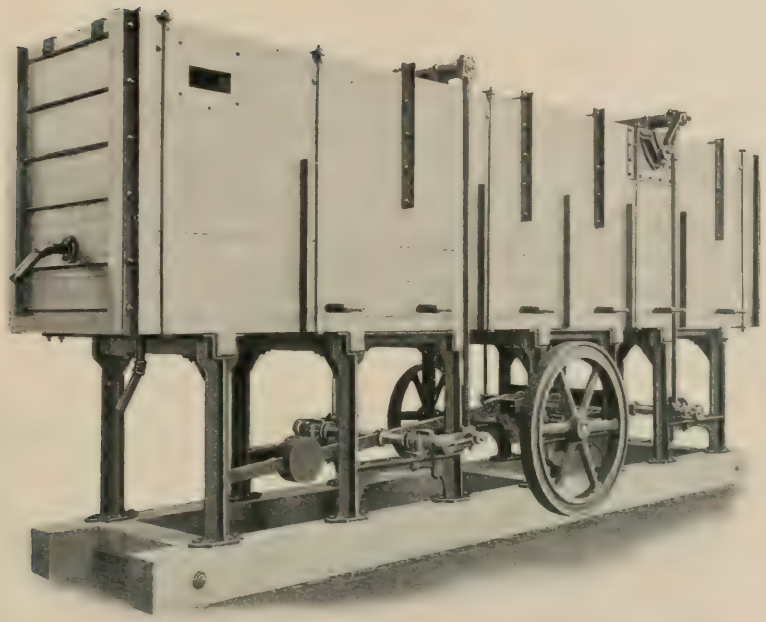
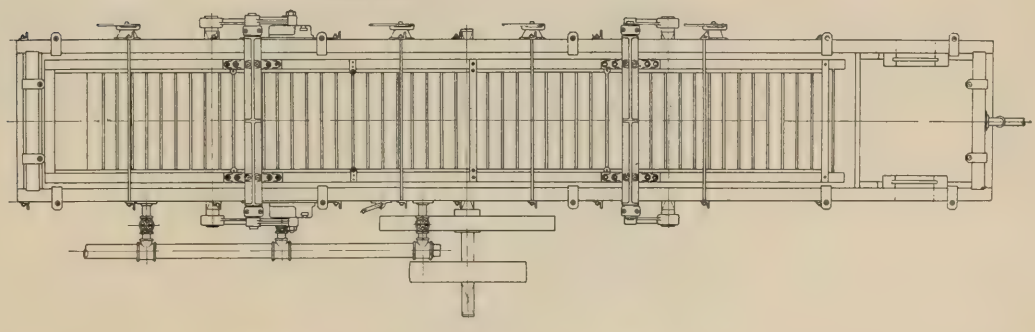
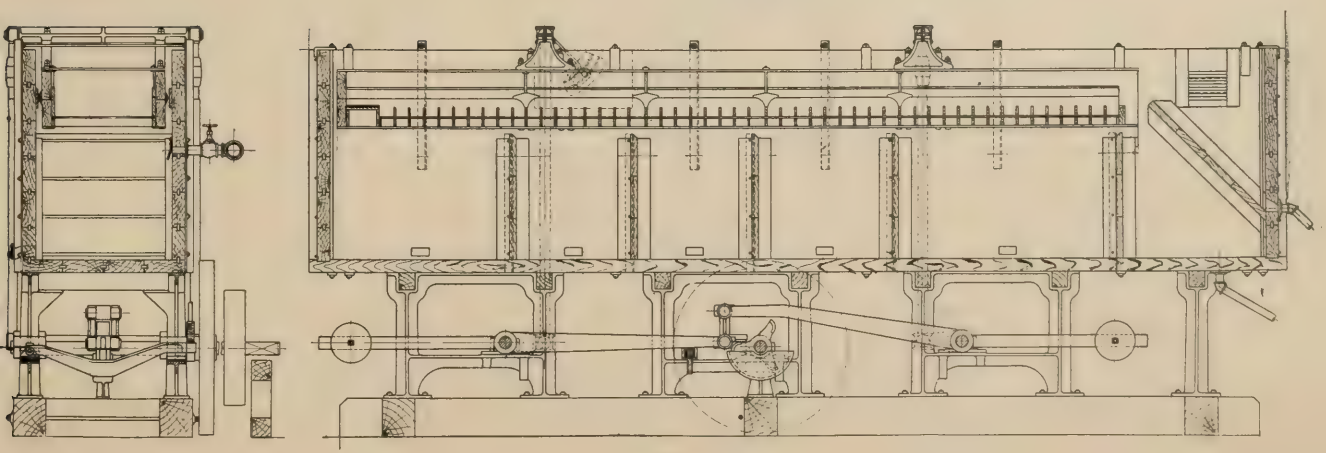


Plate 3234



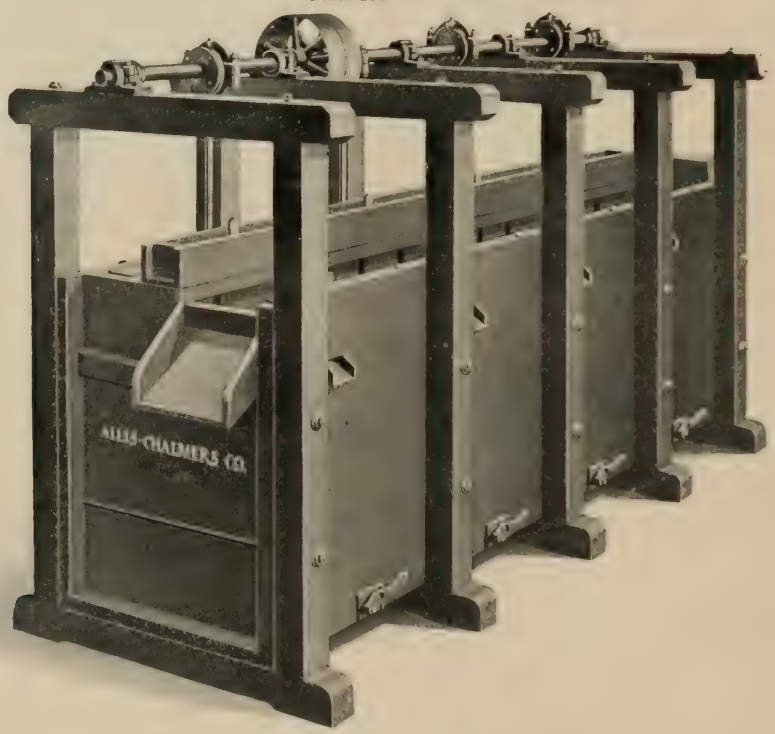


PLUNGER JIGS.

Hartz Jigs are too well-known to require any description. They are standard machines for the concentration of sized feed. We are prepared to furnish Hartz Jigs of the latest design in single or double, 2, 3 or 4 compartments.

This type of jig consists of a wood tank divided by a partition above, which does not reach the bottom. On one side of the partition is fixed a horizontal screen, on which the sized ore is fed; on the other side a loosely working plunger operated vertically by an eccentric or other reciprocating device. The action of this plunger is to cause a regular pulsation of water through the screen, so affecting the particles of ore resting thereon that the heavier particles settle down through the lighter, and either discharge through

Plate 853



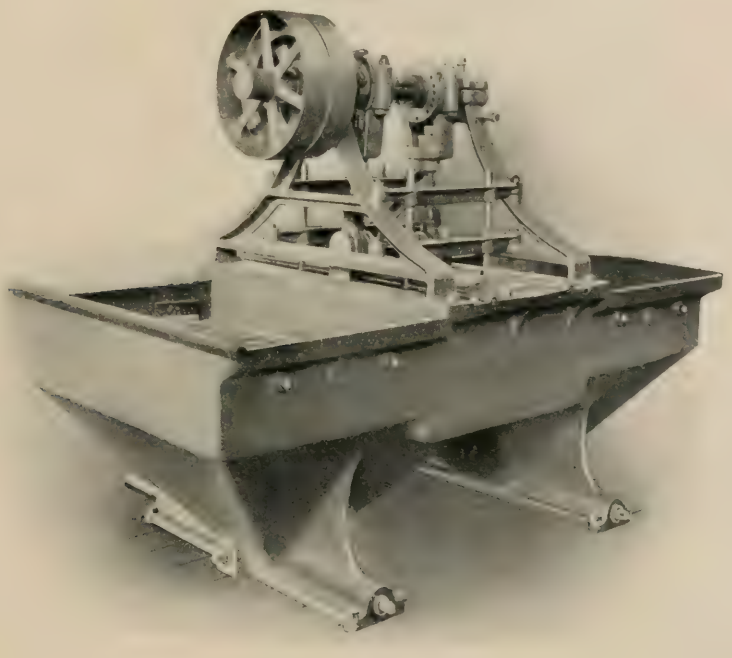
Four Compartment Hartz Jig.

screen itself or by an appropriate gate above screen level, while the lighter particles of rock move on, horizontally discharging over the side or end of screen frame. These jigs have pointed bottoms, divided longitudinally by a partition (part way down, as described), and also laterally into two or more screen spaces, discharging one upon another, and with equal corresponding plunger compartments on the opposite side of the longitudinal partition.

The jigs are 1, 2, 3 or 4 compartment, the last being generally used when more than two products are required, as for, instance, a mixture of galena and zinc blende in rock,

galena with iron or copper pyrites. In the case of 2, 3 or 4 compartment jigs, the plungers are regulated as to stroke and speed independently of each other and with reference to the work to be done respectively on the screen beds they govern.

Plate 841



All Iron Double One-Compartment Jig.

Plate 841 illustrates a double, one-compartment all iron jig of which we have sold large numbers, especially for concentrating lead and copper ores.

These jigs are provided with adjustable eccentrics variable from 0 to whatever stroke may be required, with wooden screen frames and screens of brass wire. Each compartment is provided with its own plunger operated by the eccentric and guided by two guide rods of steel running through babbitt boxes. The two plungers are worked from the same shaft, which is driven by tight and loose pulleys, the driving pulley being heavy, so as to act as a fly-wheel.

The lower part of the hutch box is hopper shaped and each side has discharge openings provided with plugs and discharge nipples of proper size.

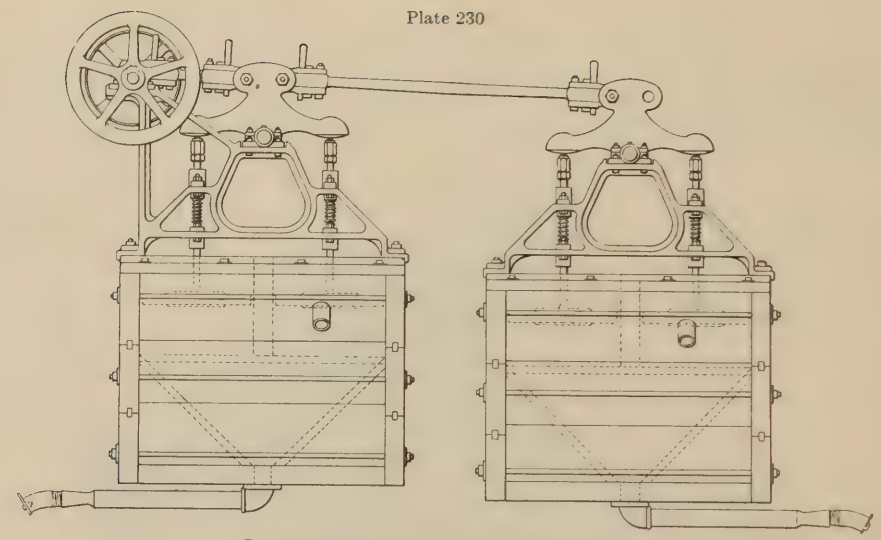
The screen surfaces of these jigs are 24″x36″ and 18″x30″.

DIFFERENTIAL MOVEMENT.

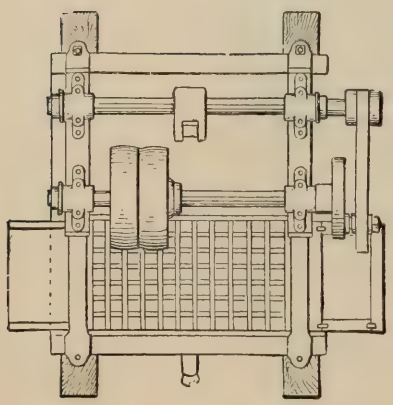
If required we make these jigs with differential stroke, giving a quick movement to the plunger going down and a slow movement coming up. This differential movement takes the place of tight and loose pulleys and does not take up any more room.

All jigs are furnished complete ready for the belt and for connection with feed and discharge apron.

Plate 230



Collom Two-Compartment Jig.

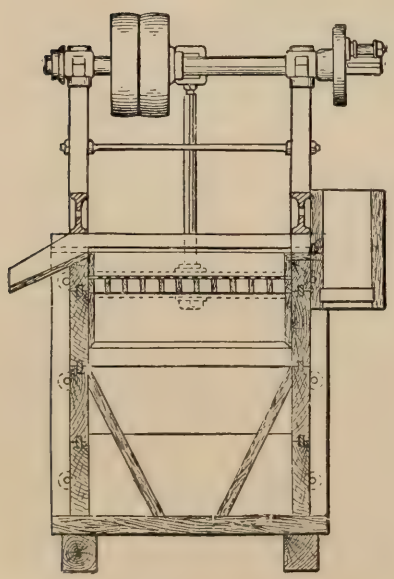


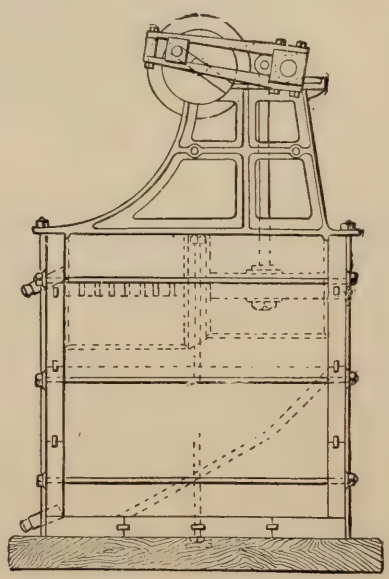
This well-known type of jig is used by such important companies as the Imuris Mines, Limited, the Butte Reduction Co. and the Anaconda Co. It is also built by us with iron boxes. The cut shows in one elevation a head and a tail, or a driving and a following jig, the latter at a slightly lower level than the former.

We build other types and arrangements of jigs to order.

SINGLE COMPARTMENT SLIDE JIG.

Plate 227

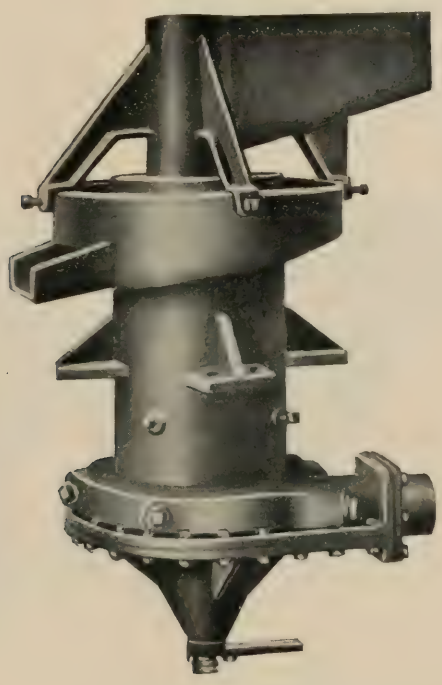




The slide jig suitable for coarse ores has an adjustable motion with quick return.

RICHARDS ANNULAR VORTEX CLASSIFIER.

Plate 5060



The wide range of sizes in jigging covered by the Hancock Jig has made necessary the design of a classifier of large capacity for an unsized feed. The Richards Annular Vortex Classifier was designed for this purpose, separating the slimes from the jig feed.

The 20″ classifier will classify an unsized feed from 3/8″ to 0. The 13″ classifier will classify material from 8 mesh to 0, generally used for reground middlings from jig.

The special features of these classifiers are:—

1—Ease of adjustment.

2—Large capacity of unsized feed.

3—Use of small amount of water.

5—Small space required.

HYDRAULIC SEPARATORS AND CLASSIFIERS.

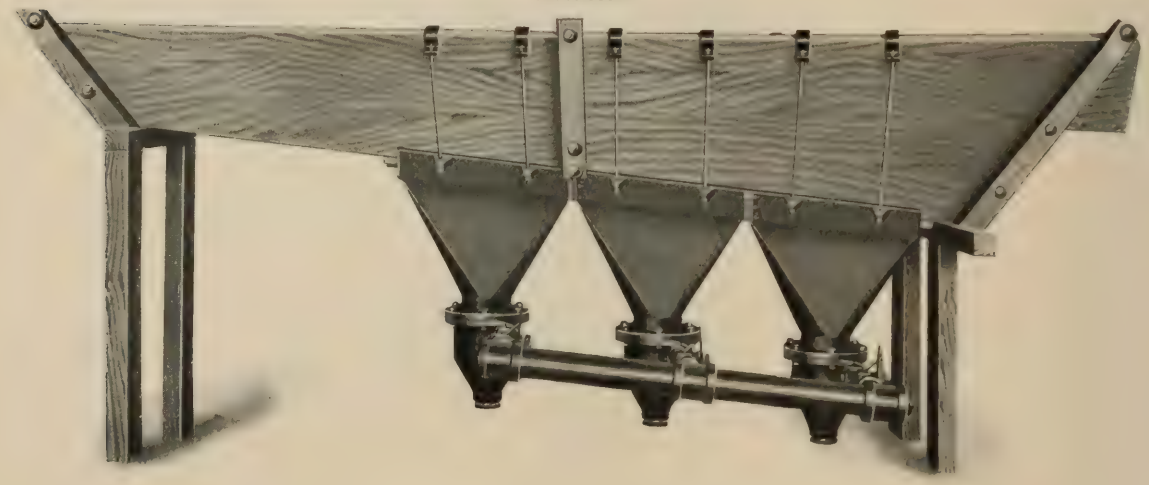
When a sufficient water supply is available, the introduction of hydraulic classifiers will, in many instances, increase the capacity of the jigs, vanners or other concentrating machinery used in the subsequent treatment of the ore, and enable the same to effect a closer separation.

We build several styles of classifiers in addition to those herein illustrated, and shall be pleased to offer to prospective purchasers our best judgment and advice concerning concentrating propositions in general. See special bulletin on this subject, No. 1434.

RICHARDS VORTEX CLASSIFIER.

To be efficient, a classifier must combine good separation, ease of adjustment, large capacity and use of minimum amount of water. The Richards Vortex Classifier, in from 1 or 5 spigots, was designed with these points in view and makes a perfect classification of sands and slimes for tables and vanners.

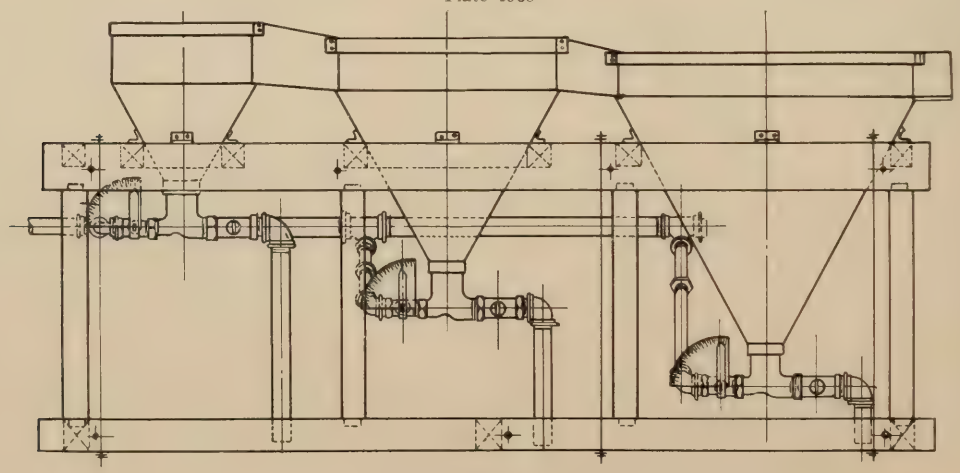
Plate 5061



CONE CLASSIFIER.

For preliminary separations, such as the material to the fine sand jig from that to the tables and vanners, a simple cone classifier, for large capacity and small amount of water is used. Two products are made, one suitable for jigging, the other for slimes treatment. Capacities range from the small sizes up to several hundred tons per day. Our line of classifiers includes many special and ingenious designs as well as all of the well-known standard.

Plate 4966



The capacity of the classifiers depends a great deal on the character of the ore, but for ordinary work the coarse classifiers can handle about 75 tons per day of 24 hours in each compartment and the classifiers for finer materials will handle about 50 tons in the same time.

THE AYTON INTERMITTENT THICK PULP EXTRACTOR

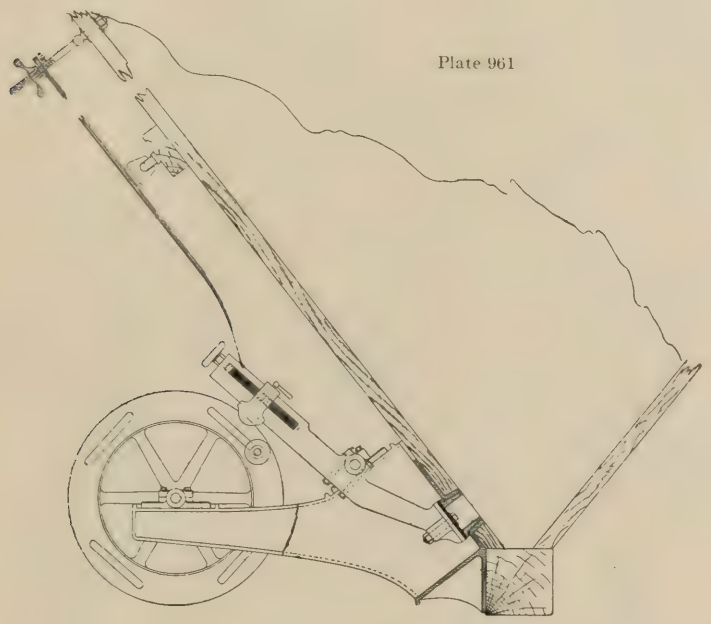


Plate 961

This device is used in connection with pointed settling boxes. Its function is to recover the thin watery pulp coming from stamps, etc., in a thickened condition and of a consistency suitable for further treatment requiring a continuous supply of thick pulp.

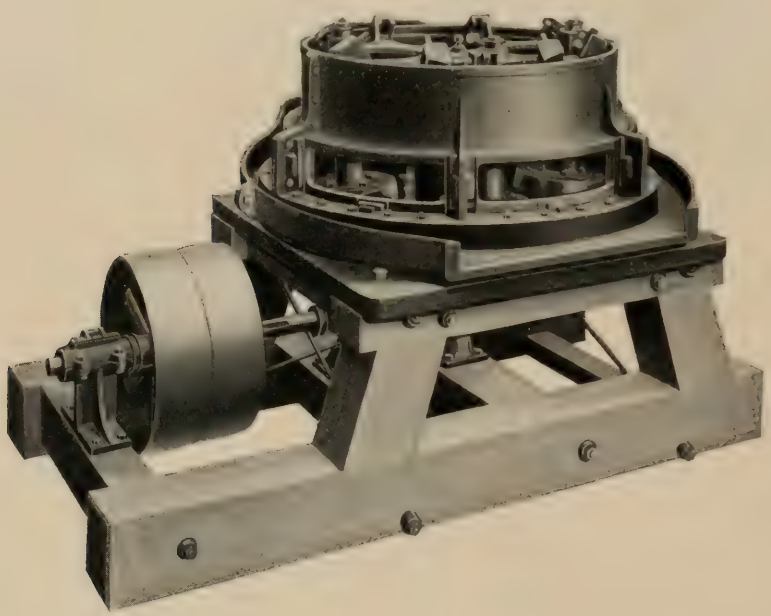
A valve is secured to the point of the settling box, the movement of the valve being controlled by a lever held in position by means of a spring and actuated by a cam movement. The extent of the valve opening and the frequency of the periods of discharge are regulated by adjusting devices. The pulp is allowed to settle or collect at the point of the box for a short period, when the valve opens and a portion of the thick settled pulp is allowed to escape, the valve being closed so quickly that the supernatant watery pulp does not reach the level of the discharge opening.

A pointed settling box, 10x10 ft. by 8 ft. 6in. deep, is of suitable proportions for the application of the pulp extractor, securing even surface currents and a uniform slope of 60° for each side of the box. Such a box has a delivering capacity of 8 to 10 tons of thick pulp per 24 hours.

Huntington Mill.

In regrinding for table or vanner treatment it is necessary to use a machine which will reduce the ore below a given maximum size, that is, by a grinding and screening process. The Huntington mill combines these operations with great efficiency. The grinding is effected between an outer steel die ring and four rollers suspended from a spider in such a way as to run on this die. Splashing of water and ore against screens in the outer casing causes the discharge of the ground ore. Our mills are designed for capacity, reliability and wearing qualities, having an extra large amount of metal in their construction. See Bulletin No. 1431.

Plate 4834



The above illustration shows the construction of our Standard 3½ ft., 5 ft. and 6 ft. regular Huntington Mills on wood frames.

The capacity, horse-power and water required, will depend upon many conditions, the principal of which are:—

1—The character of the ore.

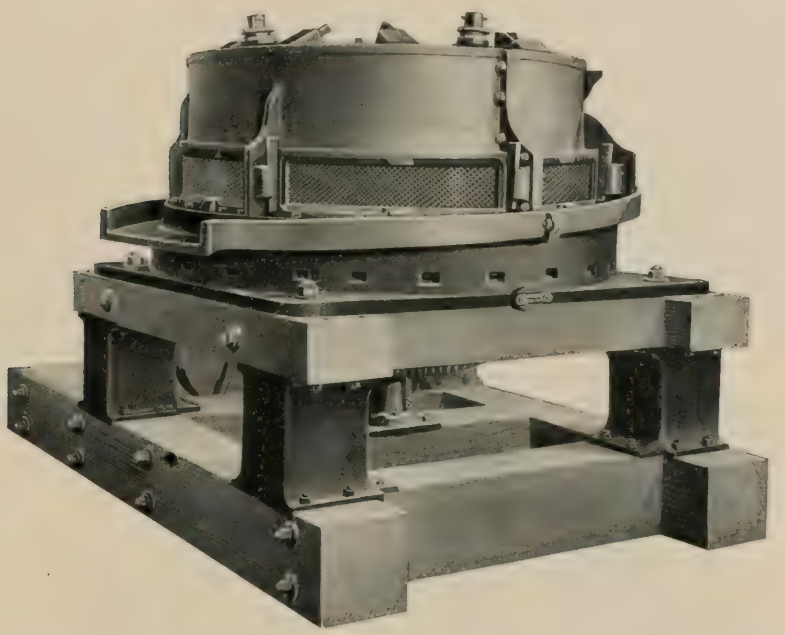
2—The size of the ore fed into mill.

3—The size of the screens through which the crushed ore must pass.

TYPE "A" HUNTINGTON MILL

This illustration shows our six-foot extra heavy Huntington Mill.

Plate 4835



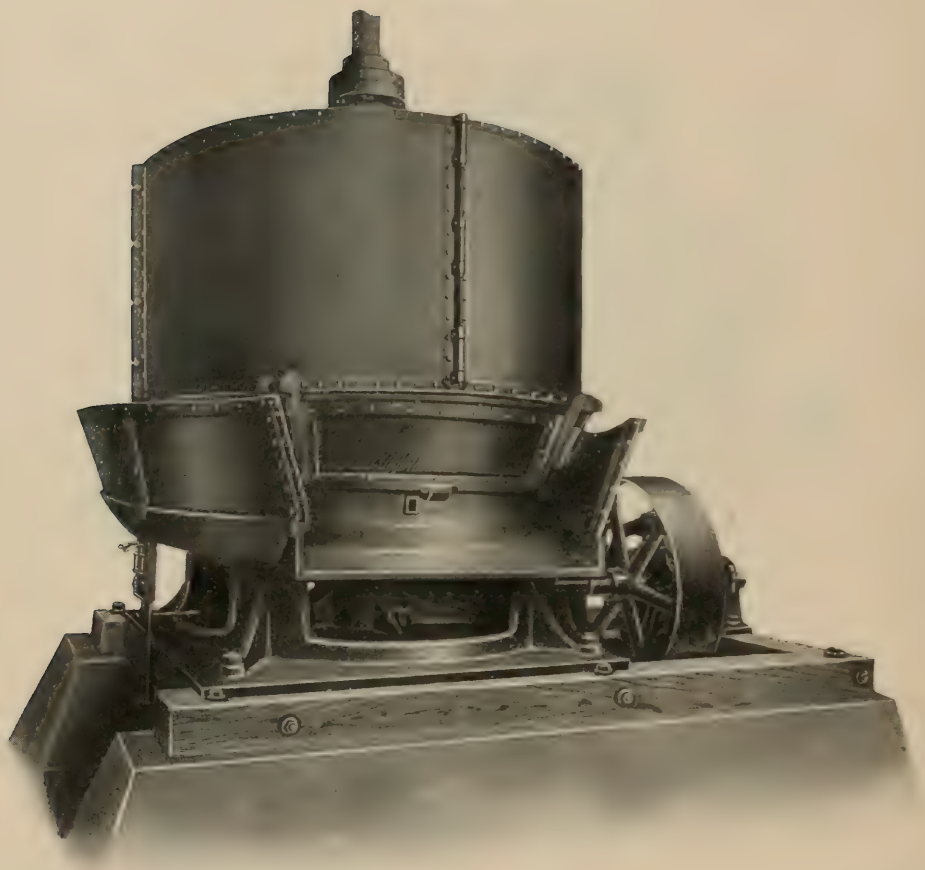
The following table gives approximate data for estimating:—

Size of Mill	Size of Ore Fed to Mill	Capacity in Tons Per 24 Hours	Size of Screens on Discharge	Water Required Per Hour, in Gallons	Horse-Power
3½-Foot	¾″ Ring	8 to 12	30 Mesh	750	5 to 7
5 -Foot	¾″ Ring	20 to 25	30 Mesh	1000 to 1200	8 to 10
6 -Foot	¾″ Ring	40 to 50	30 Mesh	1400 to 1700	10 to 14
6-Foot Anaconda	¾″ Ring	60 to 75	30 Mesh	1500 to 2000	15 to 20

Size of Mill	SIZES OF BELTS	
	Width of Belt	Ply
3½-Foot	6″	4
5 -Foot	8″	5
6 -Foot	10″	5
6 -Foot Anaconda	12″	6

CHILIAN MILL

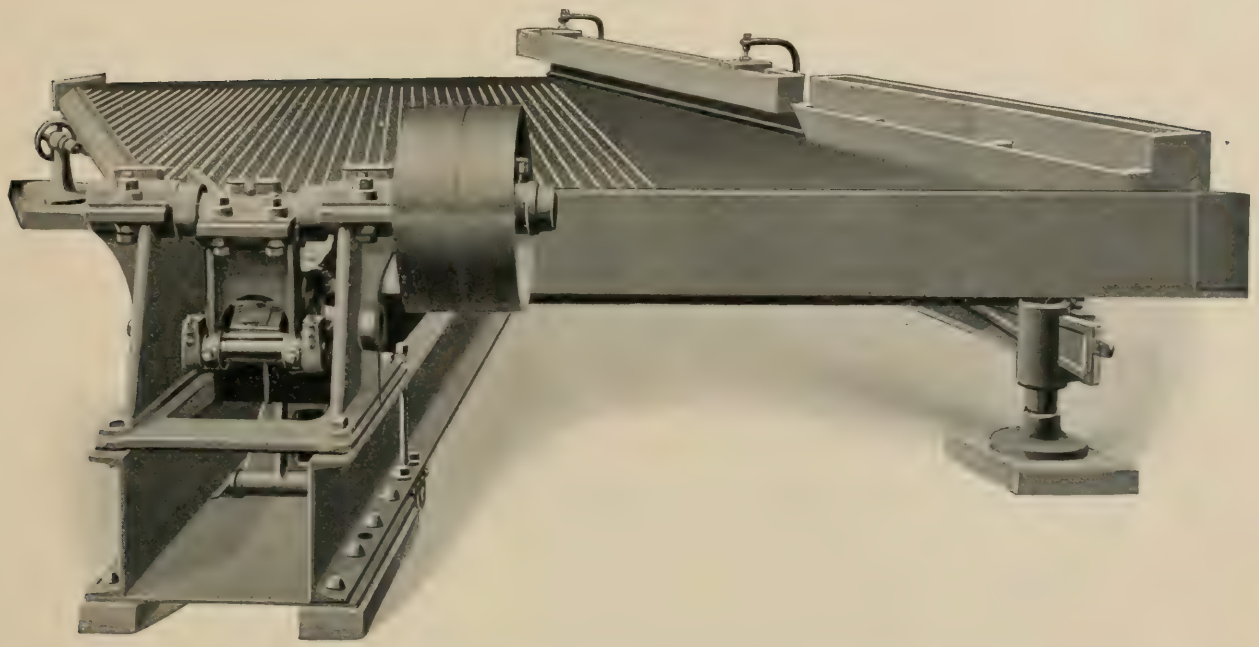
Plate 4431



This machine is often used for fine regrinding. Its heavy rollers and grinding motion result in the reduction of the ore to small mesh. Our mill is heavily proportioned and has large capacity, coupled with economy of operation and moderate cost of maintenance. Chilian mills are excellent machines where the material is extremely hard, requiring the use of a heavy roller to effect grinding.

THE OVERSTROM CONCENTRATOR.

Plate 1449



In connection with milling plants, there is generally need of some form of concentrator or slime table.

The machine illustrated above, is one of the best machines designed for the purpose of saving the fines or slimes arising from either original crushing of ore in mills or in handling the fine pulp from reground material when the mills are employed in reducing material which still contains values unreleased in the original crushing, as in the case of jig middlings.

Some of the special merits of the Overstrom Concentrator for the work it is designed to do, are as follows:

There is more effective separating surface on the Overstrom Concentrator than on any other table, and as a sequence the table has a larger capacity than other forms of concentrators.

In addition to the largest capacity, the table makes the closest concentration. The values contained in the pulp are concentrated with the least possible loss. The Overstrom Concentrator is especially a saver of the finest materials and slimes.

Another special feature of the Overstrom Table and one which should be of great interest to installers of small mill plants, is the fact that the table does not make heavy losses in the form of table middlings. A close extraction can be made in one operation. This feature obviates rehandling the material. All these special features, as enumerated above, are due to the diagonal shape of the table.

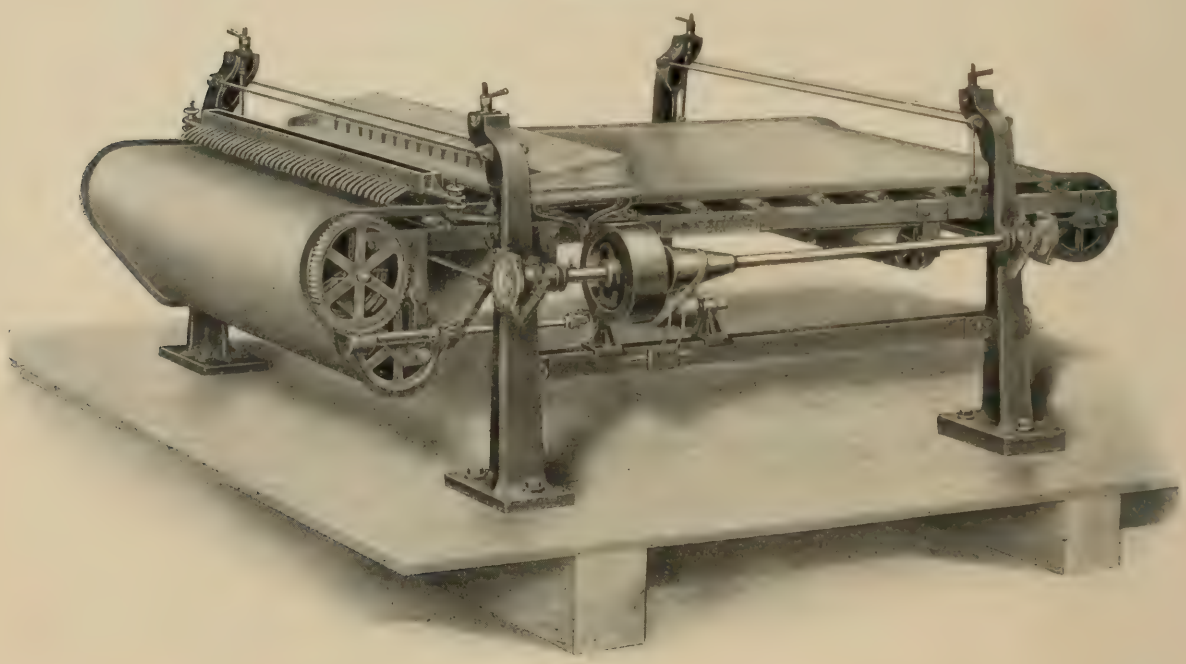
The mechanical construction of the table is perfect and much in advance of other similar types of concentrating machinery. All parts of the table, except the top, are constructed of structural steel or iron, insuring great rigidity and smoothness of action and long life and service.

The machine, when required, is shipped knocked-down and packed for mule back transportation; no piece or package will weigh over 300 lbs.

Vanners.

The vanner is one of the most important machines in a mill, since its special function is to save all of the values which have passed the other machines. As it is usually the last treatment, the mineral which passes the vanner goes to the tailings dump. Hence, the design of a vanner of greater efficiency is a boon to concentration.

Plate 4648



SUSPENDED IRON FRAME VANNER.

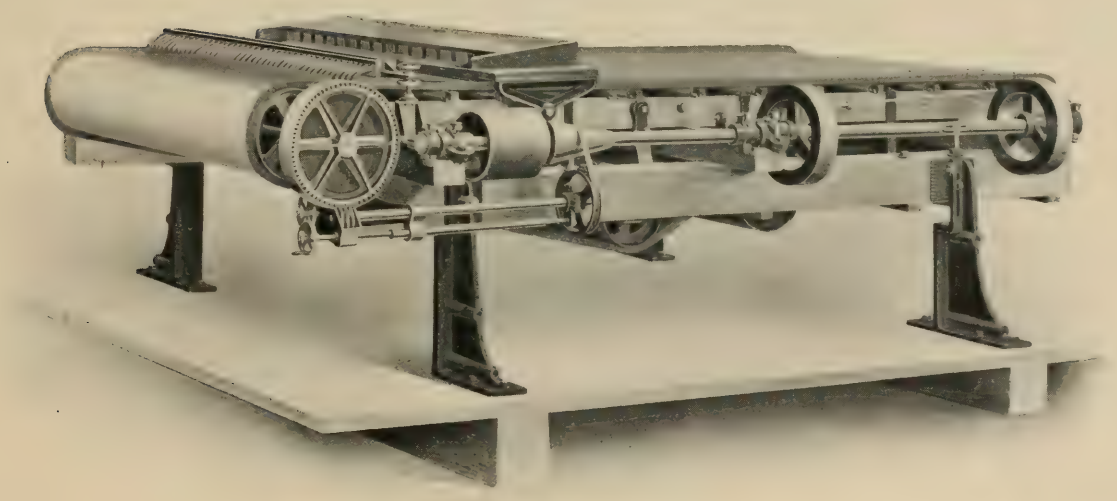
This machine is constructed entirely of iron and steel, with the exception of the pulp distributor, which is of wood. The frame is hung from two iron rods on each side, which are so arranged that the side shake imparts a peculiar motion to the belt, the longitudinal center line remaining stationary in its vertical plane while the sides are alternately raised and lowered, thus causing a panning effect so desirable in the concentration of finely crushed materials. This not only results in rapidly settling and separating the mineral from the pulp; but it also prevents the formation, along the sides of the belt, of sand corners, such as ordinarily diminish the capacity of a vanner and cause the pulp to slop over onto its working parts.

THE PRINCIPAL ADVANTAGES OF THE SUSPENDED IRON FRAME VANNER MAY BE SUMMARIZED AS FOLLOWS:

All-steel construction of the frame;
The peculiar panning motion imparted by the side shake;
Adjustable character of the motion, as regulated by eccentrics;
Independent adjustment at the four columns for regulating grade of belt;
Combined cone pulley belt tightener and adjustable support;
Universal drive for worm and worm wheel on head roller;
Interchangeability of parts;
Perfect access to all adjusting devices and clear space underneath machine.

FRUE VANNER.

Plate 4702



The Allis-Chalmers Frue Vanner has been the standard machine for fine concentration for a great number of years and is well and favorably known. A very full description of it is given in our Bulletin No. 1427. This vanner is different from the Suspended Iron Frame Vanner previously described, inasmuch as the table frame or belt frame is carried on vertical supports, instead of being suspended from hangers.

SPIRAL SAND PUMP.

Plate 846 shows two illustrations of the Frenier Spiral Sand Pump for handling the slimes and tailings from concentrators and for pumping the crushed ore, pulp in wet state, sandy and gritty water, etc., etc., about the plant.

This pump consists of a wooden tank set below the source of supply so that the liquid to be pumped is all drained into it. The pump itself is set into this tank, its shaft resting in two heavy bearings bolted to the sides of the tank and so protected that the sand and water cannot get into the bearings. At the top of the tank an overflow is placed to drain off any surplus water and sand. The pump is made with a spiral passage entirely of heavy steel plates, the sides and coils being so riveted together that the whole forms an air tight wheel as strong as any steam boiler. The pump has neither piston, cylinder, cranks, valves, buckets nor chains, hence the wearing parts are reduced to a minimum. All its working parts are above the water or material being handled, therefore readily accessible in case any part should get out of order.

At each revolution of the wheel a quantity of the mixture is scooped up and by the continued revolution is raised from the first coil to the next and so on until it is forced up into the vertical pipe to the point of delivery. These pumps are built to raise material to a height of twenty-four feet. If greater elevation is required we can furnish special pumps for the purpose.

In writing for further information, or ordering a pump, the following questions should be answered, so that we may be guided in replying or filling the order in the most satisfactory manner:

For what purpose is the pump wanted?

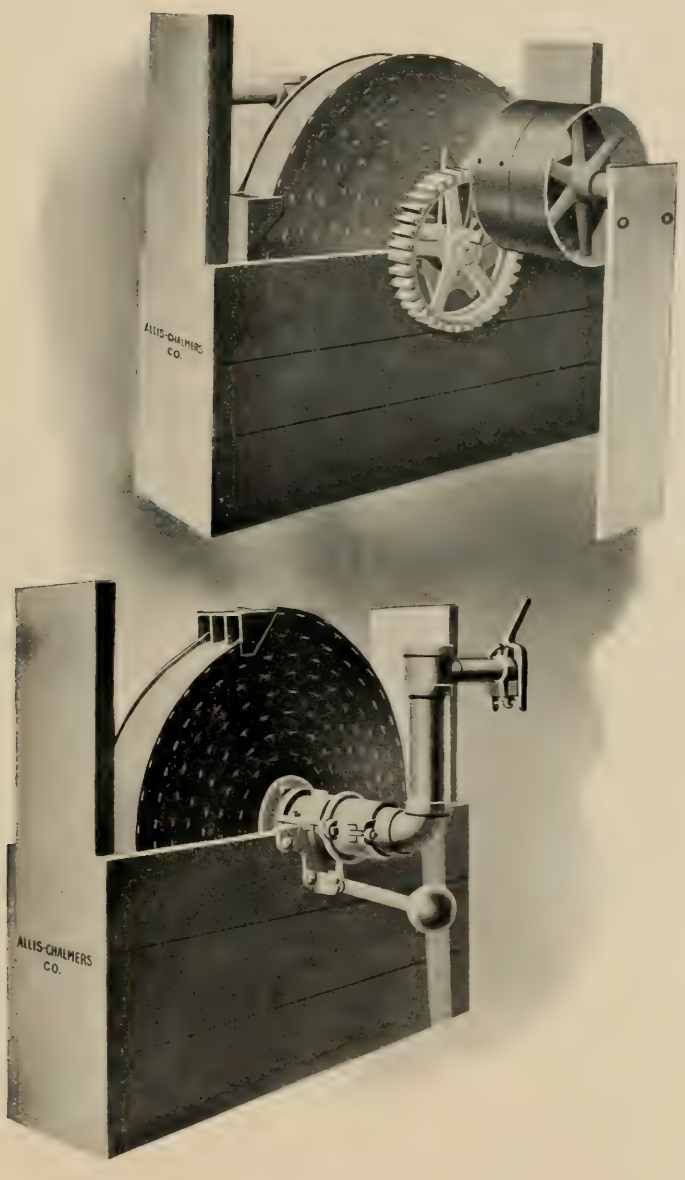
What is the liquid to be pumped? How thick?

What is the total height to which material is to be raised?

How many gallons of material are to be raised per hour?

SPIRAL SAND PUMP

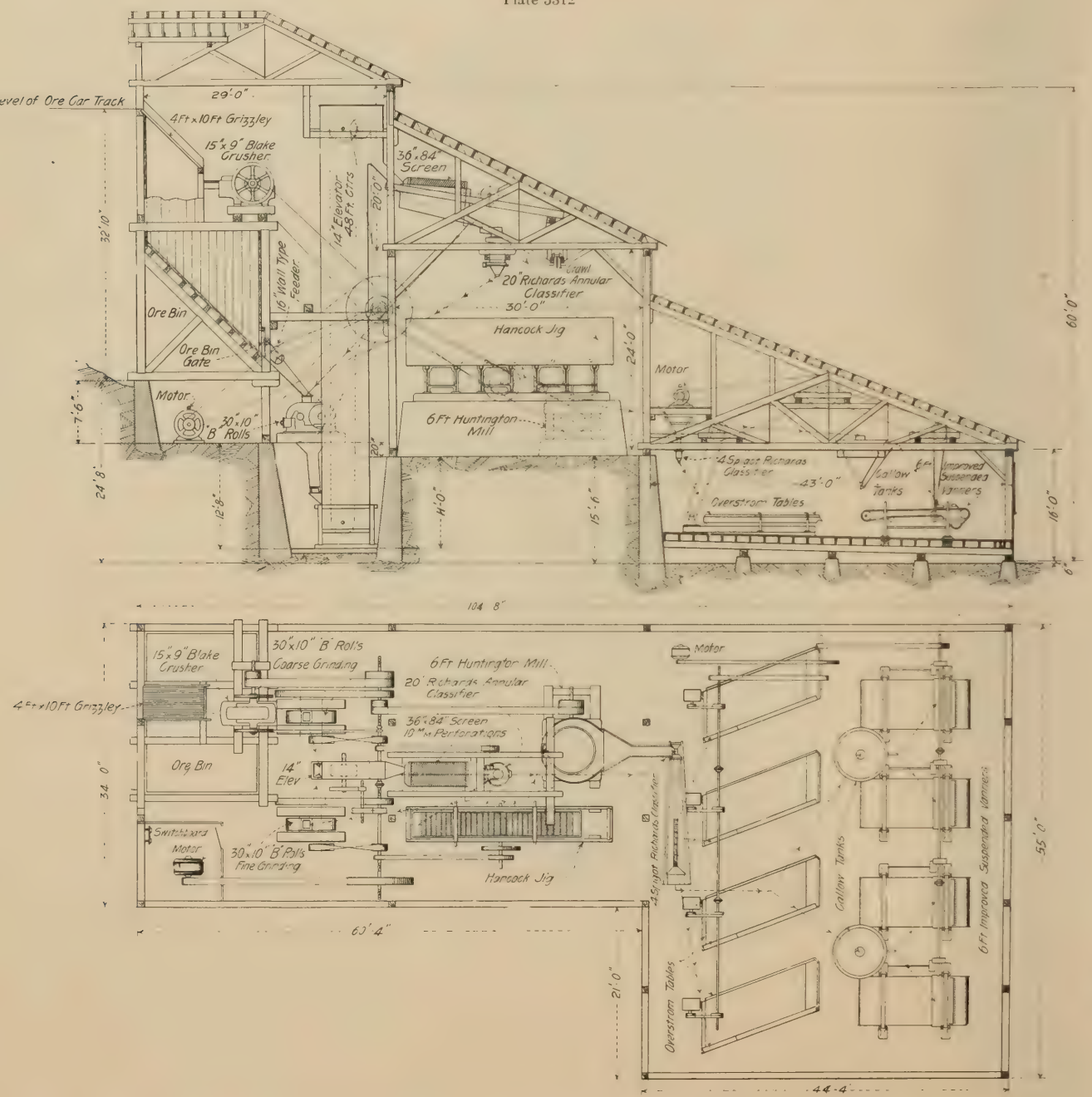
Plate 846



TWO TYPICAL CONCENTRATING PLANTS.

In the following diagram is illustrated the plan and elevation of one of our improved concentrating mills, using a Hancock Jig and Richards Classifiers; and on the opposite page the operation of the plant is graphically shown by a flow sheet. On page 40 a diagram is given showing plan and elevation of one of our improved concentrating mills using Hartz Jigs, and on the opposite page the operation of the plant is graphically shown by a flow sheet. Either mill is adapted for coarse concentration of copper or lead ores, with fine grinding for the middlings produced by the jigs and subsequent fine concentration on tables and vanners.

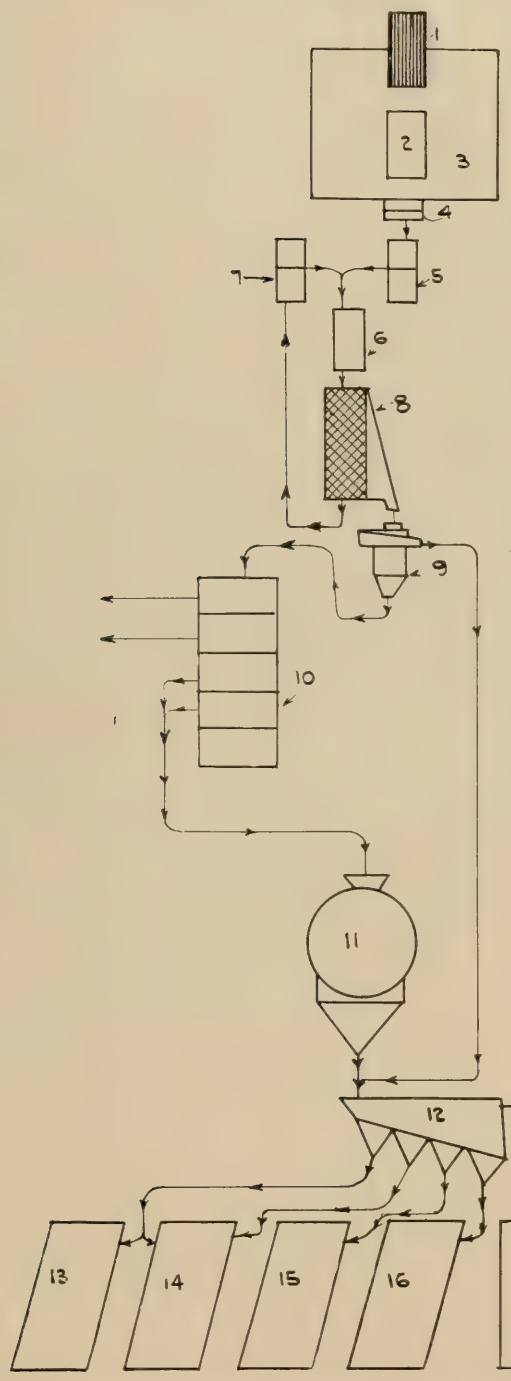
Plate 5312



Plan of Concentrating Mill using Hancock Jig and Richards Classifiers.

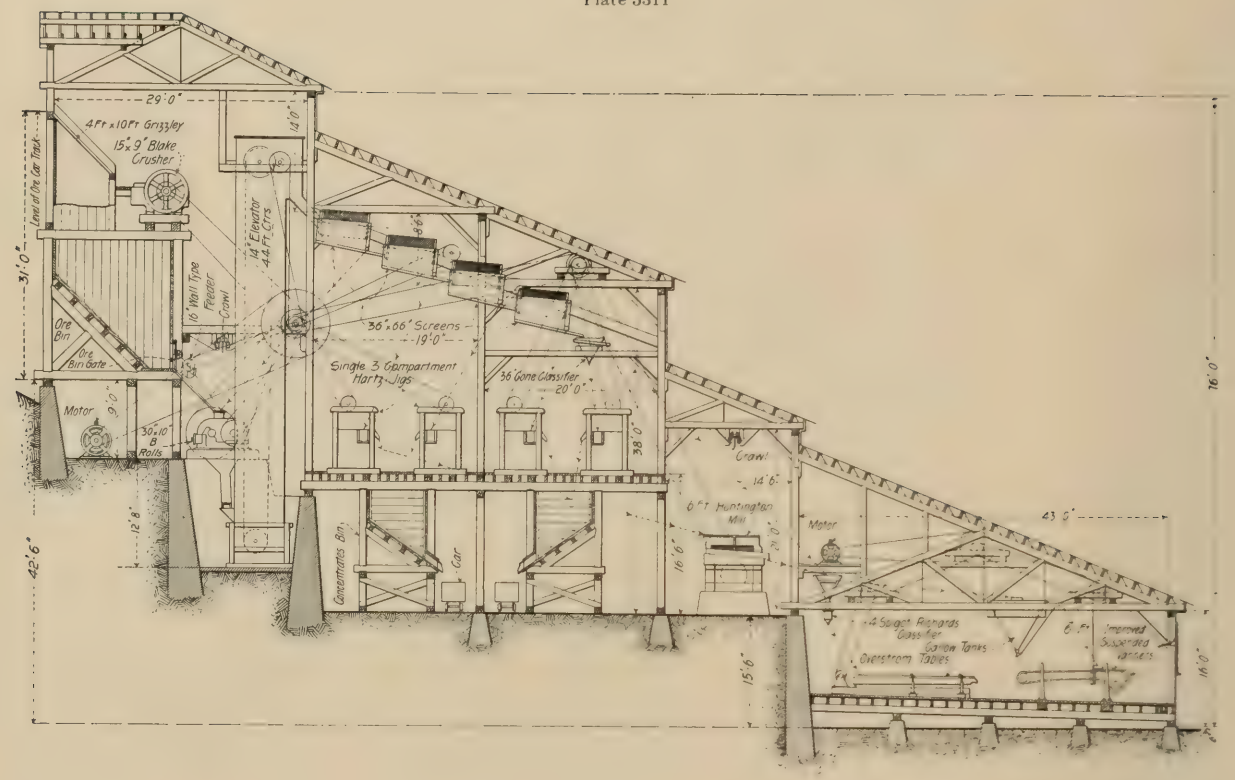
150 TO 200 TON CONCENTRATING PLANT: USING HANCOCK JIGS FOR LEAD OR COPPER ORE.

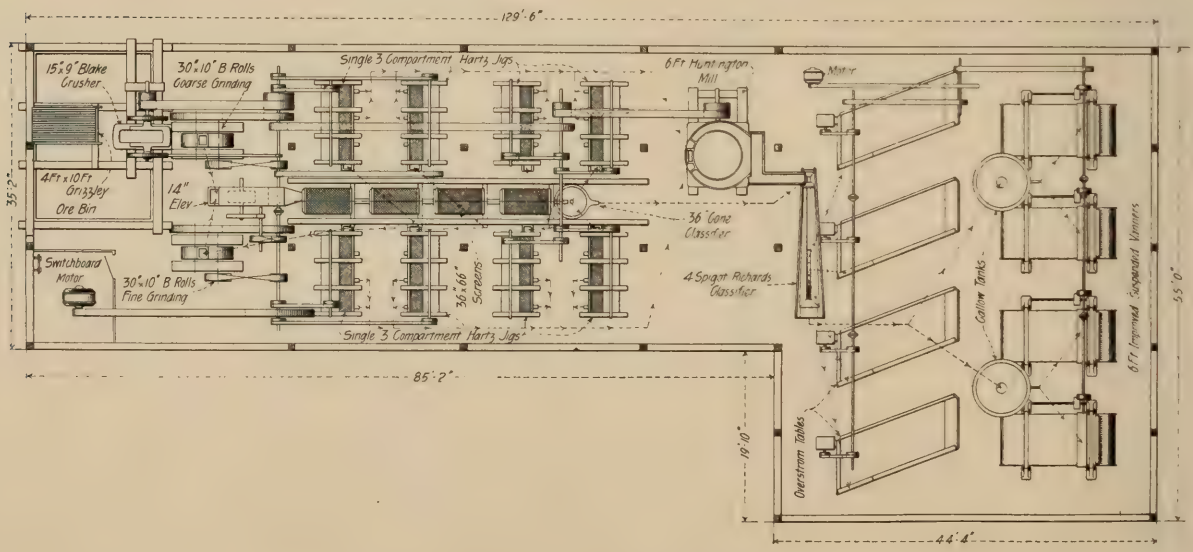
Plate 5310



1—4′x10′ Grizzley
2—15″x9″ Blake Crusher
3—Ore Bin
4—16″ Wall Type Feeder
5—30″x10″ "B" Rolls
6—14″x48′-0″ Elevator
7—30″x10″ "B" Rolls
8—36″x84″ Screen 10 M–M Holes
9—20″ Richards Annular Classifier
10—Hancock Jig
11—6 ft. Huntington Mill
12—Four-Spigot Richards Classifier
13—Overstrom Table
14—Overstrom Table
15—Overstrom Table
16—Overstrom Table
17—8′-0″ Callow Tank
18—8′-0″ Callow Tank
19—6 ft. Suspended Vanner
20—6 ft. Suspended Vanner
21—6 ft. Suspended Vanner
22—6 ft. Suspended Vanner

Flow Sheet of Concentrating Mill using Hancock Jig and Richards Classifiers.

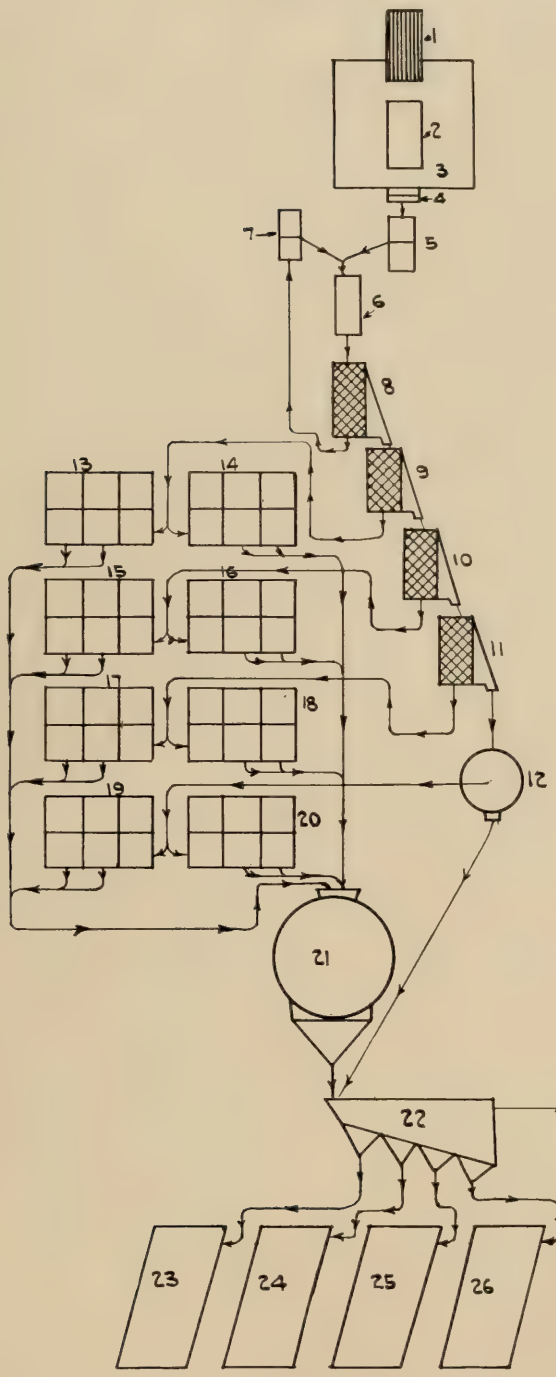




Plan of Concentrating Mill using Hartz Jigs.

150 TON, 200 TON CONCENTRATING PLANT USING HARTZ JIGS FOR LEAD OR COPPER ORE.

Plate 5309



1—4′x10′ Grizzley
2—15″x9″ Blake Crusher
3—Ore Bin
4—16″ Wall Type Feeder
5—30″x10″ Style "B" Rolls
6—14″x44′–0″ Mill Elevator
7—30″x10″ Style "B" Rolls
8—36″x66″ Screen 9 or 12 M–M Holes
9—36″x66″ Screen 6 or 8 M–M Holes
10—36″x66″ Screen 3 or 4 M–M Holes
11—36″x66″ Screen 1½ or 2 M–M Holes
12—36″ Cone Classifier
13—Three-Compartment Hartz Jig
14—Three-Compartment Hartz Jig
15—Three-Compartment Hartz Jig
16—Three Compartment Hartz Jig
17—Three-Compartment Hartz Jig
18—Three-Compartment Hartz Jig
19—Three-Compartment Hartz Jig
20—Three-Compartment Hartz Jig
21—6 ft. Huntington Mill
22—Four-Spigot Richards Classifier
23—Overstrom Table
24—Overstrom Table
25—Overstrom Table
26—Overstrom Table
27—8′-0″ Callow Tanks
28—8′-0″ Callow Tanks
29—6 ft. Suspended Vanner
30—6 ft. Suspended Vanner
31—6 ft. Suspended Vanner
32—6 ft. Suspended Vanner

Flow Sheet of Concentrating Plant using Hartz Jigs.

ELEVATION OF CONCENTRATING MILL USING HARTZ JIGS

Both of the plants illustrated in the foregoing pages are up-to-date and model mills but are, of course, subject to various modifications to suit variations in the ore to be treated.

Attention is directed to the difference in the two mills brought about by the use of our Hancock Jig and Richards Classifier. In the Hartz Jig Mill four revolving screens and a single cone classifier are used to separate the material into various sizes so that it can be properly handled on eight 3-compartment Standard Hartz Jigs.

By referring to the mill using Hancock Jigs the reader will note the simplicity and simple arrangement of the machinery, which, on account of the Hancock Jig being used, only requires one screen to return the oversize to secondary rolls. The fine material from the screen which determines the maximum size of material to be jigged goes to a Richards Annular Vortex Classifier, which has been designed for use in connection with the Hancock Jig and which makes a classification separating material finer than 30 mesh for treatment in the fine concentration section. The other product from the classifier, which ranges from the size perforations on the screen down to 30 mesh, forms the feed to the Hancock Jig.

On account of only one Hancock Jig being used in place of numerous Hartz Jigs it necessarily cuts down the floor space in the mill. These features make it possible to build a mill as much as 30% lower in cost than for a mill using the required number of screens and Hartz Jigs.

CONCENTRATING ORES.

The principal ores of Lead, Zinc, Copper and Iron given in the order of their specific gravities and showing amount of the principal metal contained in each.

No.	ORE	COMPOSITION	Per cent	Metal	Sp. Gravity
1	Chrysocolla	Hydrated Silicate of copper	39.90	Copper	2.0–2.2
2	Vivianite	Iron Hydrosphate	43.00	Iron	2.6–2.7
3	Dioptase	Copper Silicate	50.40	Copper	3.3
4	Calamine	Zinc Silicate	67.50	Zinc	3.4–3.5
5	Limonite	Iron Oxide	59.80	Iron	3.6–4.0
6	Hydrozincite	Hydrated Zinc Carbonate	57.10	Zinc	3.6–3.8
7	Atacamite	Copper Oxichloride	59.40	Copper	3.7
8	Azurite	Hydrated Copper Carbonate	55.16	Copper	3.8
9	Covellite	Copper Sulphide	66.00	Copper	3.8
10	Siderite	Iron Protocarbonate	48.20	Iron	3.8–3.9
11	Malachite	Hydrated Copper Carbonate	57.33	Copper	3.9–4.0
12	Brochantite	Copper Sulphate	70.30	Copper	3.9–4.0
13	Sphalerite (Blende)	Zinc Sulphide	67.15	Zinc	3.9–4.1
14	Willemite	Zinc Anhydrous Silicate	58.00	Zinc	3.9–4.2
15	Wurtzite	Zinc Sulphide	67.00	Zinc	4.0
16	Chalcopyrite	Copper and Iron Sulphide	34.40	Copper	4.1–4.3
17	Olivenite	Hydrous Copper Arsenate	56.10	Copper	4.1–4.4
18	Smithsonite (Spar)	Zinc Carbonate	40.00 to 52.00	Zinc	4.3–4.4
19	Chromite	Iron and Chromium Oxide	32.00	Iron	4.3–4.6
20	Pyrrhotite	Iron Sulphide	61.60	Iron	4.6
21	Hematite	Iron Sesquioxide	70.00	Iron	4.2–5.2
22	Minium	Lead Oxide	90.60	Lead	4.6–4.7
23	Tetrahedrite	Copper and Antimony Sulphide	15.00 to 48.00	Copper	4.4–5.1
24	Martite	Iron Sesquioxide	92.90	Iron	4.8
25	Marcasite	Iron Disulphide	46.00	Iron	4.8–4.9
26	Bornite	Copper and Iron Sulphide	55.60	Copper	4.9–5.4
27	Pyrite	Iron Disulphide	46.60	Iron	5.0
28	Franklinite	Iron, Zinc, Manganese Oxide	11.00 to 21.00	Zinc	5.0–5.2
29	Franklinite	Iron, Zinc, Manganese Oxide	63.40	Iron	5.0–5.2
30	Magnetite	Magnetic Iron Oxide	72.40	Iron	5.1–5.2
31	Linarite	Lead, Copper Sulphate	55.70	Lead	5.3–5.5
32	Zincite	Zinc Oxide	80.20	Zinc	5.4–5.7
33	Chalcocite	Copper Sulphide	79.89	Copper	5.5–5.8
34	Tenorite	Copper Oxide	79.80	Copper	5.8–6.2
35	Cuprite	Copper Oxide	88.80	Copper	5.8–6.2
36	Arsenopyrite	Iron Sulpho-arsenide	34.30	Iron	5.9–6.3
38	Anglesite	Lead Sulphate	68.30	Lead	6.1–6.4
39	Cerussite	Lead Carbonate	77.52	Lead	6.5–6.6
40	Pyromorphite	Lead Phospho-Chloride	69.50	Lead	6.5–7.1
41	Wulfenite	Lead Molybdate	60.70	Lead	6.7–7.0
42	Vanadinite	Lead Vanadate	78.70	Lead	6.7–7.2
37	Mimetite	Lead, Arsenic Oxide	74.90	Lead	6.4
43	Wolframite	Iron Tungstate	9.50	Iron	7.2–7.5
44	Galena	Lead Sulphide	86.57	Lead	7.4–7.6
45	Stolzite	Lead Tungstate	49.00	Lead	7.9–8.1

WATER.

1 cubic inch = .0361 pounds

27.7 cubic inch = 1 pound

1 cubic foot = { 62.4245 pounds at 39° F. / 7.48 gallons / 8.33111 pounds (distilled) }

1 Gallon U. S. = { 8.34 pounds (ordinary practice) / 231 cubic inches }

1 Gallon imperial = { 10 pounds at 62° F. / 277.274 cubic inches }

1 pound pressure = 2.31 feet in height

1 foot in height = 433 pounds

Approximate Bottom Velocities of flow in channels at which the following materials begin to move.

.25 feet per second, microscopic sand and clay

.50 feet per second, fine sand

1.00 feet per second, coarse sand

1.75 feet per second, pea gravel

3.00 feet per second, smooth nut gravel

4.00 feet per second, 1½″ pebbles

5.00 feet per second, 2″ square rocks

MINER'S INCH.

Is a unit of rate of discharge of water, expressed in terms of a standard orifice. This is usually 1 inch square with a head of 6 inch. The flow is equivalent to 10.96 gallons per minute.

TABLE 376—CARKEEK'S SLOPE FOR LAUNDERS.

Size of Ore	SLOPES	
	Degrees	Inches per Foot
2 inches to 1 inch	37° 50′	9.33 Wet
1 inch to ½ inch	33° 40′	8. Wet
½ inch to ¼ inch	29° 5′	6.66 Wet
¼ inch to ⅛ inch	24° 0′	5.33 Wet
⅛ inch to $\frac{1}{16}$ inch	18° 25′	4. Wet
$\frac{1}{16}$ inch to vanner material	7° 35′	1.6 Wet
Table or vanner material	6° 20′	1.33 Wet
Tail race for material $\frac{1}{16}$ inch in diameter	3° 35′	0.75 Wet
Tail race for material ⅛ inch in diameter, or larger	6° 20′	1.33 Wet
Trommel casing for material less than ½ inch	16° 15′	3.5 Wet
Trommel casing for material larger than ½ inch	33° 40′	8. Wet

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Which may be had upon application.

100 Spanish Mining & Crushing Machinery.
127 Sampling Plants & Equipment. (Edition nearly exhausted.)
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1400 Gold Dredges.
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INSTRUCTION BOOKS.

5000 Instructions for Setting and Running Style "D" Gates Rock and Ore Breakers.
5001 Directions for Erecting and Operating Frue Vanner.
5002 Instructions for Setting and Operating Style "K" Gates Rock and Ore Breakers.
5004 Directions for Erecting Gates Elevator.
5005 Instructions for Setting and Operating Gates Tube Mill.
5006 Directions for Setting and Operating Gates Ball Mill.

Power and Electrical publications issued by Allis-Chalmers Company, which may be had upon application to the Department of Publicity, Milwaukee, Wis.

BULLETINS

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1038 Alternating Current Generators, Engine, Fly-Wheel, Belted and Water-Wheel Types.
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